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ABSTRACT

This document reports the findings of a project that focused on three main activities: (1) taking inventory and annotating existing data collections related to an understanding of the application and implications of information technologies (IT) in the home; (2) developing an annotated bibliography of articles, books, and reports that present research about or analyses of the application and implications of IT in the home; and (3) integrating the findings from this research to present what existing evidence says about the application and implications of IT in the household sector, and identifying any caveats regarding these findings and any significant gaps in coverage. This report is divided into six categories; (1) an overview of the state of knowledge and inquiry into the adoption and impacts of IT in the home; (2) a conceptual framework for analysis of these issues; (3) the sociodemographics of access and adoption; (4) patterns of IT use; (5) research on impacts; and (6) a concluding section that discusses the information gaps and analytical needs in this field of inquiry. (Contains 58 references.) (YDS)

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Division of Science Resources Studies
Directorate for Social, Behavioral, and Economic Sciences
National Science Foundation

February 2001

The Application and Implications of Information Technologies in the Home: Where Are the Data and What Do They Say?

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EXECUTIVE SUMMARY

The National Science Foundation's (NSF's) Division of Science Resources Studies (SRS) contracted with SRI International's Science and Technology Policy Program to undertake a project entitled *The Application and Implications of Information Technologies in the Home: Where Are The Data and What Do They Say?* The objective of the project was to develop a consolidated information base on the role of information technologies (IT) in the home for use by NSF, SRS, and the larger research and policy communities. The resulting information base consists of three main components:

- An inventory of U.S. national datasets containing data on the use and consequences of IT in the home, with accompanying annotations of each dataset.
- An annotated bibliography of principal articles, books, and reports that present research about or analyses of the use and implications of IT in the home.
- An integrated overview and assessment of the current state of knowledge and evidence concerning the use and consequences of IT in the household sector.

Our current knowledge about the status and impact of IT in the home comes largely from scholarly studies that generate original data and from policy analyses of the existing national datasets related to home IT. What we know may be briefly summarized as follows.

ACCESS TO HOME IT

- In 1998, approximately 42 percent of American households owned a personal computer (PC), and one-quarter of American households had access to the Internet. The diffusion of home computers grew faster from 1994–98 than in any period since 1984.
- The patterns of IT diffusion and adoption clearly suggest that IT is still very much a resource acquired by more affluent and well-educated Americans. Although PCs have been diffusing rapidly in recent years, rates of adoption are still much lower in poor and minority households compared to affluent and white homes.
- The research for both PC and Internet adoption indicates that socioeconomic factors (such as income, level of education, and marital status) and demographic factors (such as age, sex, and ethnicity) continue to be the primary predictors of home IT access.
- Very simply, income allows families to hurdle affordability barriers to adoption, and well-educated individuals are more likely to be aware of and appreciate the ways IT can be used in the home.
- Racial/ethnic disparities in home access to IT typically cannot be explained by income or level of education alone. There are deeper cultural and social factors influencing the adoption process, but these factors have not been empirically identified or isolated.

HOME IT USE

- The recent wave of home computer adoption has gone largely unexamined by scholars and analysts; our empirical knowledge of home computing dates from the early to mid-1980s. This early adopter research suggests that the primary use of home computing was for education, play, work, and basic word processing. Sizable proportions of early adopters found that they used the computer less than they had initially expected, and, in one long-term study, nearly one-fifth of families had quit using their PC entirely within 2 years. It is not clear whether this under-utilization was due to the inability of the technology to meet needs within the family, the relative lack of quality software for the early computers, or other factors.
- Early-adopter findings generally suggest that children tended to use home PCs more often and for longer periods than adults. Strong differences by sex also appeared in some studies. Women and girls overall appeared to use the computer less often and less intensively than their male counterparts, and were much less likely to be heavy users of the technology. Children tended to use the computer for games, learning, and writing in roughly balanced proportions—no one application dominated use, although game playing was the most common reason children gave for using the computer.

- Recent research on Internet use reinforces some of the impressions generated by the early computing studies: children and male teenagers still tend to be the heaviest users of IT.

- The Internet has made a new form of interpersonal communication available, and several analyses suggest that e-mail and communication drive use of the Internet by individuals and households.

- Specific informational content derived from the World Wide Web is relatively unique to each individual's interests and needs, but broad patterns of information use emerge. Americans most often seek information related to health and leisure. Affluent and educated individuals also use the Internet for work, while socioeconomically disadvantaged groups use the Internet to seek jobs and take classes.

Home IT Impacts

- Research on the actual impacts of IT on home, family, and individual household members is *extremely limited in scale and scope*. The areas of impact covered include (1) time displacement studies, (2) the impacts of teleworking on the home, (3) psychological well-being, (4) informatics and healthcare, and (5) the impact of video games on children. A general theme of the impact research is the dual nature of home IT—it can be both beneficial and harmful.

- Home computing and Internet use do not yet appear to displace other forms of home media and entertainment (reading, watching television, listening to the radio) substantially. While there does appear to be some slight displacement of television viewing, several analysts suggest that PCs and the Internet are media enhancing: people begin to use other forms of media more often as they become more acquisitive of information.

- The research on teleworking generally predates major changes in distributed work arrangements in large-scale organizations, so the findings may have limited applicability to the contemporary workplace. Studies indicate that telework can demonstrably enhance people's ability to better balance work and family needs and reduce personal stress. On the other hand, telework can also disrupt important family dynamics and relationships and create psychological isolation and low self-esteem. Most research on telework/distributed work focuses on efficiency and productivity, and not on the impacts on individual workers or their homes.

- With respect to psychological well-being, there is mixed evidence regarding the impact of computing on individuals. Some data suggest that increasing Internet use is associated with social isolation, withdrawal, and stress—although Internet "addiction" may be limited to about 10 percent of Internet users and isn't necessarily associated with how much time an individual spends on the "Net." Conversely, some studies suggest that Internet use enhances family connectedness and friendship formation.

- Patient health informatics are an emerging class of tools designed to help individuals understand their medical conditions and more effectively participate in decisions about treatment and care. The limited research on home health informatics suggests that patients who used these tools had higher levels of understanding about their medical conditions and treatment choices compared to those who did not.

- The impact of video games on children may provide insight into the impact of computer games on children. Evidence is found for both positive and negative behaviors associated with the use of video games, but also for neutral outcomes. For example, video game playing does not necessarily make children less sociable, and these games appear to be more intellectually challenging and stimulating than television on several key empirical measures of both affect and stimulation. Of cause for concern is the strong preference of boys for more aggressive video games, and for these preferences to be associated with more aggressive behavior and reduced sociability.

Availability and Utility of Data on IT in the Home

Although data that address basic questions regarding home access to computing and the Internet are readily

available, our ability to analyze meaningfully the consequences of IT in the home is hampered by three crucial factors. First, there is a lack of data collection on the actual impacts of computer and Internet use on homes, families, and individual household members. Second, there is an absence of routine, detailed data collection on home computers and computing. Third, there is a bias toward proprietary (and costly) commercial databases with limited accessibility by the policymaking and scholarly communities. In addition:

- Relatively few data resources on IT in the home exist that meet standards of acceptable quality for policy or scholarly analysis. Only half a dozen survey efforts provide data obtained through valid sampling methods that are able to be generalized to large portions of U.S. households and that are for more than 1 year of activity.

- There is a data collection bias toward Internet access and use. Detailed information related to patterns of home computing are limited to two sources of data, the Bureau of the Census' Current Population Survey and the Pew Research Center for the People and the Press' Technology Survey. Neither survey is conducted on a regular basis. The ability to conduct meaningful trend analysis is consequently nonexistent.

The existing data do allow us to analyze some developments in the diffusion and adoption of home IT. The data address who has access to a computer—or the Internet—in the home, and by relatively detailed demographic and socioeconomic characteristics (for example, income, race, age, and level of education). We can also describe, in a basic way, how important some computing applications are relative to others (for example, word processing versus game playing). And we know, in a broad way, what people do on the Internet: use e-mail and search for information, particularly health-related content.

However, because of the limits to current data collection and resources, we cannot answer fundamental questions regarding the role and importance of IT in American homes. For example, how do families and individuals use information gained from the World Wide Web and with what consequences? What are the outcomes of the growing role of e-mail in some families' lives? Are they any better off than families without e-mail? Do PCs meet a home's needs and desires, or will the recent rush to purchase computers lead to disappointment and abandonment by families with naive hopes for the technology and overly high expectations? Does the PC have any greater role and purpose as a family tool than it did 20 years ago? How does the presence of home computing affect family dynamics and relationships? Does it diminish or enhance quality of life, and under what circumstances? Are there pathologies associated with extensive Internet use? How does computer-based work at home affect the nature of home itself? How effective are families at managing the Information Age with home IT?

Because we cannot answer these fundamental questions, we cannot address whether the inequities that exist in access to home information technologies matter, and how. The implicit assumption is that the absence of IT in the home will perpetuate social and economic disadvantages. Individuals and families cannot build the computing skills needed for today's labor force; important educational resources cannot be availed; and information needs go unaddressed. Minorities, the "underclass," and other groups in American society have traditionally been "informationally disadvantaged"; these groups tend to have fewer lines of access to information, the quality and accuracy of their information are low, and their information networks are simply less enriching than those available to the rest of society. Those deprived of quality information suffer from compromised decision-making and problem solving related to their quality of life and well-being. Can home IT ameliorate these disadvantages? Will (or do) these groups compensate for lack of home IT access through other means, such as using IT resources at libraries and kiosks?

It is cliché to call for more surveys, more data collection, and more research. However, it is also clear that the data needed to answer fundamental questions about the impact of IT on the home are lacking. We simply do not know whether the presence of these technologies in the home "makes a difference," how, and whether it is worth the costs.

PREFACE

THE INFORMATION TECHNOLOGY IN THE HOME PROJECT

Information technologies (IT)—which includes technologies for data storage and retrieval, computing, and communication, and their direct and indirect applications—are transforming our lives. Although researchers in many fields have gathered data about people's IT use, the data are of highly variable quality; there has been little integrated analysis, and the overall impact of the phenomena is not clear. Important information about the shape and direction of IT use, and especially its impact in the home, remain uncharted.

In light of the above, the National Science Foundation's (NSF's) Division of Science Resources Studies (SRS) contracted with SRI International's Science and Technology Policy Program to undertake a project on "The Application and Implications of Information Technologies in the Home: Where Are the Data and What Do They Say?" The project's objective was to develop a consolidated information base for SRS, NSF, and the larger science and policy communities to use in building knowledge on the application and implications of IT in the home and how these vary depending on the household setting and who is using the technology.

The project comprised three main activities:

- inventorying and annotating existing data collections related to an understanding of the application and implications of IT in the home;
- developing an annotated bibliography of articles, books, and reports that present research about or analyses of the application and implications of IT in the home; and
- integrating the findings from this research to present what existing evidence says about the application and implications of IT in the household sector, and identifying any caveats regarding these findings and any significant gaps in coverage.

The data inventory (contained here as appendix A), annotated bibliography (appendix B), and integrated overview (which is the remainder of this report) are available on the World Wide Web for use by science and policy communities and the general public at http://srsweb.nsf.gov/it_site/it/infotech.htm.

For the purposes of this project, IT is defined as consisting of home computers and other devices for accessing information sources, primarily the Internet. "In the home" is defined as topics related to the use and impacts of IT in or by households, but excluding topics specifically related to home office use, as well as general IT topics such as privacy, decency, security, and IT-based education and electronic commerce, *unless* they are specifically related to the impacts on home users.

Through this project, SRS was particularly interested in building a picture of the applications and impacts of IT in the home and how these vary by population group and household setting. Data resources and literature addressing the following questions are thus included:

- How many households have purchased or otherwise obtained access to IT?
- Who in the household is using IT (e.g., age, sex, education, occupation)?
- What kinds of IT are used, and what are they used for (e.g., education; leisure/entertainment; household tasks, operation, or management; shopping; household records; financial activities; personal communication)?
- What is the impact of IT (for example, on the cost or convenience of household operations; shopping; money management; frequency and nature of interactions among household members, immediate neighborhood and community, and cyber community)?
- How have applications and impacts of IT in the home changed over time?
- What are the key determinants of access to telecommunication links? What are the key determinants of the decision to adopt one or more forms of IT?
- How do the answers to these questions vary among people, groups, and household settings?

The Dataset Inventory

The dataset inventory was assembled from a variety of sources, primarily the World Wide Web (WWW), since most IT-related resources tend to have a substantial Web presence. In addition, several staff members of the Graphic, Visualization, and Usability (GVU) Center at Georgia Tech who are responsible for GVU's WWW User Survey were interviewed.[1] Dataset resources were also identified during the literature annotation phase of the project.

To qualify for inclusion in the dataset inventory, resources had to meet the following criteria:

1. Data on information technology in the home had to be obtained through valid sampling methods, whether random or nonprobabilistic samples.

2. Data had to be obtained from samples of the entire U.S. population.

3. More than 1 year of comparable data had to be available.

The datasets included also needed to be generally available, be based on research that could be generalized beyond the particular study population, and be documented.

These criteria excluded a number of potential data sources. Notably, scholarly works generating original data were not included in the dataset inventory. There are a large number of surveys conducted by academics during the course of research projects. However, these surveys are not generally available to the research community at large. For the most part, these surveys are unrepeated snapshots, often not generalizable beyond the population of the survey, and often not documented. Thus, scholarly research that generated *original* data is not included in the data inventory. However, these data are covered in the IT Issues Bibliographic Database, particularly among the annotated documents on IT in the home.

Additionally, while sources of other data on IT in the home occasionally surface in the press or on Web metasites for IT—including, for example, market research from IntelliQuest, Odyssey, and the Yankee Group, as well as special surveys by trade associations and others—these were not included largely because no descriptions of the data and methods for these studies could be located.

The data inventory shows that there are only limited sources of data related to the diffusion and adoption of IT in the home that can be reliably generalized to the U.S. population. Moreover, analysis of the inventory's contents reveals three inherent problems in current IT data collection efforts:

1. There is a bias toward access to, and uses of, the Internet. As a consequence, detailed information related to patterns of home computer usage is limited to two sources of data (see point 3 below).

2. The main sources of highly detailed data on Internet access and use are proprietary commercial databases. It is doubtful that these data can be released in any degree of useful detail to the public domain.

3. The two sources of detailed, publicly accessible data on computers and the Internet—the Census Bureau's Current Population Survey and the Technology Survey of the Pew Research Center for the People and the Press—are not conducted on a regular cycle. Since IT adoption and diffusion are occurring rapidly, these surveys are conducted too infrequently to provide timely data and information.

The Annotated Bibliography

Written works used to construct the bibliographic database related to the impacts of IT in the home were collected in four ways:

- **Keyword search.** A number of databases were searched using a series of keywords to identify works related to IT in the home. The search process was iterative and was repeated with varying keywords until most results were works appropriate to the topic. The author names that appeared most frequently were then subjected to further searches for additional relevant works. The resulting works were then subjected to a series of computer searches and analyst review to verify relevance. Works of borderline significance were retained.

[1]GVU has researched many of the survey and data collection activities about computers and the Internet; these are linked to its website.

- **Networking.** Known experts in the field were queried by e-mail and asked to suggest works they considered particularly important to the topic.

- **Ad hoc discovery.** Relevant works were discovered during Web searches, from reviews of bibliographies of other works, and from voluntary submissions.

- **Bibliographic research.** Nearly 50 bibliographies contained in relevant works were examined. Those bibliographies either confirmed relevant works already on the list or identified additional works to include.

Approximately 100 works were identified as potential candidates for annotation; after these were read and evaluated, the list of candidate works shrank to 30.[2]

The screening criteria for works to be annotated were relatively generous. Basically, if an item of literature focused on IT in the home, if it came from a credible source, and if it passed modest standards of rigor, it was included as a candidate. Several reasons explain why relatively few works met these criteria:

1. The topic (IT in the home) is rather narrowly confined to impacts within the home itself.

2. Much of the IT/home/society literature is highly philosophical and speculative, and therefore not appropriate to a project to identify primarily scholarly and empirical works.

3. There was a notable amount of mismatch between titles and abstracts of works and their actual content. Studies that, on their face, should have been highly relevant to this project turned out to be nothing more than rhetoric or discussions of new technologies.

4. Scholars may publish several similar versions of their work; when such duplications were found, only one was included among the annotated works.

There are two notable gaps in the scholarly literature. The first is the virtual absence of true impacts analysis and research; rather, most empirical studies focus on home IT adoption and use patterns. Second, the research on the adoption of home computers dates from the early to mid-1980s; the accelerated adoption of home personal computers in the 1990s has gone more or less unexplored, although at least one large study is currently under way.

The Integrated Overview

The following sections present an integrated overview of the data resources and major works related to the application and implications of IT—that is, home computers and other devices for accessing information sources, primarily the Internet—in the home. This material thus summarizes the state of knowledge and data on home IT diffusion, adoption, patterns of use, and impacts.

[2]Some very recent works that may have been published since the searches were undertaken may be missing from the list, but this is a perennial problem given the pace of development in the IT field.

BACKGROUND

Since the commercial introduction of the personal computer (PC) in the late 1970s, computer-based information technologies (IT) have been increasingly adopted and used in American households. Many experts and policymakers believe these technologies will have profound social impacts, and the steady expansion of the Internet in the 1990s has triggered a new wave of interest in the impacts of IT on the American home and family.

This report represents a 20-year retrospective on what we know and do not know about how information technologies are adopted and used in the home and with what consequences. In most respects, data and research on these questions are limited: fewer than 10 major data sources exist that address these issues in a broadly generalizable way, and only 30 major conceptual and empirical works were identified. On the other hand, the rapid diffusion of computer-based home informatics has only recently begun—the fastest rates of growth have been in the past 5 years, particularly as the cost of PCs has dropped to under $1,000. An inventory of the existing data and literature is thus a crucial exercise for anticipating the likely impacts of IT in the home and for highlighting gaps in knowledge.

Although the variety of information technologies for the home is vast, the data resources and literature covered here reflect two very specific types of IT: home computers and home Internet linkages,[3] not the full spectrum of home informatics or the ways in which people can access the Internet outside the office (such as in libraries, kiosks, or Internet cafes). Excluded too are uses and applications of IT related to, for example, telephones, faxes, and other types of telecommunications equipment; VCRs and television-based media; audio technologies; "smart" appliances; and "smart house" technology.[4] These were determined from the outset to be outside the current scope of work.

The social impacts of IT in the home can be either outside or inside the household. *External impacts* would reflect, for example, the influence of home IT on culture and values, democratic participation, or social cohesion. *Internal impacts* would address changes in individuals, the family, or home-level dynamics. This study addresses only internal impacts. The data and literature on home IT discussed here focus on family- and household-level dynamics of IT; research involving individual effects are included if the context of the research is generally home computing or personal Internet use. Excluded, therefore, is research that relates to the impacts of home IT on business or society. For example, the substantial literature on the impacts of telecommuting on business productivity, job satisfaction, employee turnover, and other economic benefits is not addressed here. Similarly, the philosophical literature on the role of home IT in society, culture, democracy, and psychological perceptions of time and space, as well as other broad external impacts, was excluded.

The report is organized into six major sections. The first is an overview of the state of knowledge and inquiry into the adoption and impacts of IT in the home, and the second presents a conceptual framework for analysis of these issues. The next three sections summarize the research and findings related to access to home IT and adoption dynamics, patterns of IT use, and the impacts of IT on the home and family. The concluding section discusses the information gaps and analytical needs in this field of inquiry.

[3]Note that there is increasing diversity in technical access to the Internet; for example, through television (Web TV) and telephone. Such alternative mechanisms are not explicitly addressed in this study; most of the research reviewed here assumes Internet access through a PC.

[4]For useful discussions of home informatic technologies, see Miles et al. (1988), chapter 5; Cawson, Haddon, and Miles (1995); Miles (1988); and Venkatesh (1996).

State of Knowledge and Inquiry

Beyond a basic understanding of how widely diffused personal computers and Internet linkages have become in the United States, our knowledge of the implications of IT for the home is limited. We have yet to model and explain the IT adoption dynamics of the mid- to late 1990s, and still have no real sense of the impacts of IT on the home.[5] Data that reliably explain national patterns of computer and Internet access and use originate from six institutions (table 1), three of which are commercial market research organizations.[6] Of the eight major datasets available for national analysis (appendix A), five focus almost exclusively on the Internet. There is thus less immediate attention on the role and purpose of personal computing in the home, and a near total neglect of computing/information media such as interactive CD-ROMs and educational and entertainment software.

Data Resources

Investigation of potential sources of data for analyzing access to, and use of, IT in the home yielded few resources that could be used to generate statistically valid findings that could be generalized across the United States. Few publicly available data collection efforts represent national probability samples, which seriously limits the degree to which conclusions can be drawn about the U.S. population. In all, six sources of data can be used to describe American patterns of IT adoption and use in the home. These sources, together with a description of the data they collect, are presented in table 1. (The methodology for constructing this data resource inventory and more detailed descriptions of available data are presented in appendix A.) Table 1 also includes a survey focused on public attitudes toward science and technology (as opposed to acquisition and use of technology) that also asks some questions about IT access and use.

As noted, three of the six institutions are commercial market research firms. Prices for their IT data are relatively costly, although they vary considerably, ranging from $1,500 to $10,000 for a single year or single dataset. While publicly available, the expense of these datasets may inhibit scholarly research; moreover, because the data are proprietary, it is unlikely that highly detailed analyses may be published or otherwise reported in the public domain.

These data resources pose other limitations as well. For example, although a rich source of information, Georgia Tech's World Wide Web (WWW) User Survey is a nonprobability sample and cannot be used to make statistical inferences to the U.S. population. Also, only the Pew Research Center for the People and the Press and the Bureau of the Census collect detailed data on home computing. Unfortunately, neither of these organizations field their surveys on a routine basis, so there is no predictable and reliable source of national data on home computer access or use; this is particularly problematic given the rapid diffusion of PCs over the past several years.

Most of the data resources derive from national, random digit dial telephone surveys that yield national probability samples. Such methods can, however, generate different estimates of home IT use. Summaries of random digit dial techniques can be found in Clemente (1998) and Riccobono (1986). Hoffman, Kalsbeek, and Novak (1996) provide a detailed comparison and discussion of the methods and estimates generated by the CommerceNet/Nielsen Internet Demographic Survey, the American Internet User Survey, and the Pew Research Center for the People and the Press' IT in the American Home Survey.[7] The computer and Internet supplements to the Current Population Survey (CPS) are the only national probability samples that do not derive from telephone sampling frames; household samples are based on the actual 1990 census. All of these surveys collect a variety of detailed information related to user demographics and Internet (or computer) usage patterns; Internet data are particularly focused on types of use (e-mail versus other services) and intensity of use (frequency and duration of access). Only the CPS has traditionally collected data related to respondents' race/ethnicity.[8]

[5] While a certain amount of insightful research was conducted on adoption dynamics in the early 1980s, this describes early adopter behaviors only.

[6] There are three other commercial research firms that provide data on IT in the home—the NPD Group, PC Meter, and Media Metrix. These are *not* included here for reasons related to their documentation and generalizability (appendix A).

[7] Hoffman, Kalsbeek, and Novak find that most differences in these survey estimates can be accounted for by how Internet use is defined in the survey and how population measures are weighted.

[8] The CommerceNet/Nielsen Internet Demographic Survey began collecting race/ethnicity data in 1997.

Table 1. Sources of publicly accessible data related to IT use in the home

Source	Survey title	Methodology	Type of data collected
CommerceNet	CommerceNet/Nielsen Internet Demographic Survey	Probability sample, random digit dial telephone survey of ~5,000 Americans and Canadians aged 16 and over. Conducted semiannually since 1995	Computer access, Internet access, main focus on Internet user characteristics and Internet usage patterns
Cyber Dialogue[1]	American Internet User Survey	Probability sample, random digit dial telephone survey of ~13,000 households; in-depth surveys of ~2,000 Americans aged 18 and over. Conducted semiannually since 1994	Computer access, Internet access, main focus on Internet user characteristics and Internet usage patterns
Graphics, Visualization, and Usability Center at Georgia Tech	WWW User Survey	Nonprobability sample; voluntary, Web-based questionnaire widely advertised on the Internet. Conducted semiannually since 1994; respondents now number ~5,000	Internet only, highly detailed user characteristics and general usage patterns
International Data Corporation	Work-At-Home Survey	Probability sample, random digit dial telephone survey of ~2,000 U.S. households. Conducted annually since 1996	Nature of home working, technology acquisition and use, user characteristics, attitudes, telecommuting
The Pew Research Center for the People and the Press	1998 Technology Survey, Technology in the American Home Survey	Probability sample, random digit dial telephone surveys of ~1,200–3,000 Americans age 18 and over. Surveys conducted periodically from 1994–98	Computer access, Internet access, user characteristics, computer usage patterns, Internet usage patterns
U.S. Bureau of the Census	Current Population Survey, computer and Internet supplements	Probability sample, telephone or personal interviews with ~47,000 households. Surveys conducted in 1984, 1989, 1993, 1994, 1997, 1998	Computer access, Internet access, user characteristics, computer usage patterns, Internet usage patterns
National Science Foundation	Survey of Public Attitudes Toward and Understand of Science and Technology	Probability sample, random digit dial telephone survey of approximately 2,000 adults residing in the U.S. conducted biennially since 1972; computer-related questions added in 1983	Computer access, Internet access, user characteristics, some computer and Internet usage patterns

[1] Cyber Dialogue also fields the Cybercitizen Finance and Cybercitizen Health Surveys. The methodologies for these differ from the American Internet User Survey and focus more narrowly on the use of the Internet for personal finance and health purposes.

In sum, the ability to do a comprehensive analysis of access to, and use of, IT in the home is hampered by two crucial factors: the absence of routine, detailed data collection on home computers and computing; and a bias toward proprietary databases with limited publication potential. The one Internet survey that is conducted regularly and freely available, the WWW User Survey, is a nonprobability sample; it also lacks the detail and depth of the commercial surveys. The CPS computer and Internet supplements and the Pew surveys on technology in the American home have good potential as comprehensive sources of home computer and Internet data, but neither set of surveys is conducted regularly. In addition, neither the CPS or Pew survey items explicitly address the outcomes or impacts of IT in the home; the data collected are largely descriptive and are not focused on the consequences of IT use.

Existing Literature

The literature on the impacts of IT in the home can be organized into three broad categories:

- philosophical and speculative literature about outcomes;
- conceptual literature that tries to provide heuristic models for analyzing home IT diffusion, adoption, use, and outcomes; and
- empirical research related to these phenomena.

In general, this analysis excluded philosophical and speculative literature. It identified 30 major conceptual and empirical works related to the adoption and impacts of IT in the home. Appendix B presents a methodological overview and annotated bibliography of these works; a subject bibliography is presented in appendix C. The empirical literature is summarized briefly below; the conceptual literature is synthesized in the following section.

The empirical research comprises three distinctive types of studies. One group of studies attempts to measure overall diffusion and adoption rates of IT in the home (Clemente 1998, Hoffman, Kalsbeek, and Novak 1996, NTIA 1995, and NTIA 1998). Another group of studies can be characterized as research on the early adoption of home computers dating to the early to mid-1980s (Caron, Giroux, and Douzou 1989; Dickerson and Gentry 1983; Giacquinta, Bauer, and Levin 1993; McQuarrie 1989; Riccobono 1986; and Vitalari, Venkatesh, and Gronhaug 1985). A third body of research focuses almost exclusively on Internet adoption patterns and usage behaviors (Clemente 1998; Egger and Rauterberg 1996; Hill and Hughes 1998; Hoffman and Novak 1998; Katz and Aspden 1997; Kraut et al. 1996; Kraut, Lunmark et al. 1998; and Kraut, Mukhopadhyay et al. 1998). The major empirical works identified by this study are presented in table 2, together with a brief description of their purpose, research dates, methods, and ability to be generalized to a population outside their sample frames.

Two major research programs are currently under way that directly pertain to the adoption and impacts of IT in the home. The HomeNet study based at Carnegie Mellon University is a longitudinal study of approximately 100 families and their Internet use. The participating families were given subsidized computers, free Internet access, and computer/Internet training as a way of eliminating the socioeconomic and technical barriers to home IT access and use. Data are collected from a variety of surveys, home interviews, and electronic logs; although they cannot be generalized to the U.S. population as a whole, the HomeNet findings are nonetheless highly suggestive of American Internet behaviors. For more information, see Kraut et al. (1996) and the HomeNet home page at http://homenet.andrew.cmu.edu/progress/.

The second study is the National Outlook for Automation in the Home (NOAH), conducted by the Center for Research on Information Technology and Organizations at the University of California–Irvine. Project NOAH has two phases; the first was a 2-year longitudinal study of computer owners; the second, which is currently under way, is primarily focused on assessing the use of new IT and media in the home and their impacts on family and work life. For more detail, see the Project NOAH home page at http://www.crito.uci.edu/noah/.

Table 2. Major empirical works related to adoption, use, and impacts of IT in the home

Author	Purpose	Year of data	Research design	Can be generalized beyond sample
Caron, Giroux, & Douzou (1989)	To evaluate dynamics of home computer adoption and use	1983, 1985	Mail questionnaire to 4,300 French-Canadian viewers of an educational computer program aired in Quebec	No
Clemente (1998)	To profile Americans' Internet usage patterns	1994–97	American Internet User Survey, a national random digit dial telephone survey of ~13,000 respondent households	Yes
Dickerson & Gentry (1983)	To profile PC adopters based on technological experience and creativity	1981	Mail questionnaire to ~1,000 members of a computer club and subscribers to *Psychology Today*; demographic and psychographic variables compared for adopters and nonadopters	No
Egger & Rauterberg (1996)	To explore whether heavy use of the Internet reflects addictive behavior	1996	Swiss-based survey publicized and posted on the Web for voluntary participation	No
Giacquinta, Bauer, & Levin (1993)	To analyze how children use the computer at home for educational purposes	1984–86	Case studies of 70 middle/upper middle class families in the tri-state New York City area; content analysis of field diaries and interviews	No
Gurstein (1991)	To assess the impact of home-based computer work on the home	1989	Survey of 45 homeworkers and 9 office workers in California	No
Hill & Hughes (1998)	To compare Internet political activists to the general public and Internet users who are not politically active	1995–96	Statistical analysis of the Pew Research Center for the People & the Press survey data on IT in the American home; data are derived from national random digit dial telephone surveys of ~3,000 individuals	Yes
Hoffman, Kalsbeek, & Novak (1996)	To provide baseline data on the size of the Internet population	1995	Statistical analysis of the CommerceNet/Nielsen Internet Demographic Survey, a national random digit dial telephone survey of ~6,000 respondents	Yes
Katz & Aspden (1997)	To determine how Internet use affects community involvement	1995	Random digit dial phone survey of 2,500 households	Not available to determine
Kraut et al. (1996)	To provide a 1-year snapshot of Internet usage patterns by families	1995–96	Analysis of data obtained for ~48 families from the HomeNet field trial of residential Internet use; a detailed study of approximately 100 families in Pittsburgh, PA and their Internet usage patterns	No

Table 2. Major empirical works related to adoption, use, and impacts of IT in the home

Author	Purpose	Year of data	Research design	Can be generalized beyond sample
Kraut, Lundmark et al. (1998)	To determine the relationship between extensive Internet use, social involvement, and psychological well-being	1995–96	HomeNet field trial of residential Internet use, a detailed study of approximately 100 families in Pittsburgh, PA and their Internet usage patterns	No
Kraut, Mukhopadhyay et al. (1998)	To determine the relative importance of interpersonal communication, information acquisition, and entertainment to Internet users	1995	HomeNet field trial of residential Internet use, a detailed study of ~100 families in Pittsburgh and their Internet usage patterns	No
McQuarrie (1989)	To explain variation in PC usage patterns based on product factors, social integration, and adopter resources	1984	Mail surveys of computer owners who returned a coupon to a market research firm, ~3,500 surveys sent in both the pilot study and main study	No
NTIA (1995)	To present key findings on the degree to which home access to computers and the Internet are becoming universal in the U.S.	1994	Statistical analysis of November 1994 CPS data conducted by the Bureau of the Census; questions cover home computer access and usage and home Internet access and usage	Yes
NTIA (1998)	To present key findings on the degree to which home access to computers and the Internet are becoming universal in the U.S.	1997	Statistical analysis of October 1997 CPS data conducted by the Bureau of the Census; questions cover home-computer access and usage and home Internet access and usage	Yes
Novak & Hoffman (1998)	To analyze racial differences in access to, and use of, home computers and the Internet	1996–97	Statistical analysis of CommerceNet/Nielsen Internet Demographic Survey, a national random digit dial telephone survey of ~6,000 respondents	Yes
Riccobono (1996)	To provide a national picture of out-of-school learning activities by Americans and types of learning resources used	1995	Home Information Technology Study conducted by the Department of Education; a random digit dial telephone survey of ~4,700 respondents	Yes
Riley & McCloskey (1996)	To report the results of a 6-month pilot program on telecommuting conducted by GTE Corp.	1993	Survey data obtained from 120 project participants	No
Robinson, Barth, & Kohut (1997)	To determine if home computing and Internet use displaces the mass media as a source of news	1994–95	Statistical analysis of the Pew Research Center for the People & the Press survey data on IT in the American home; data are derived from national random digit dial telephone surveys of ~3,000 individuals	Yes
Venkatesh & Vitalari (1987)	To analyze how households adopt new PC technologies and patterns in PC usage	1984	Survey data obtained from 282 computer club members in Orange County, CA	No

IT IN THE HOME: A FRAMEWORK FOR ANALYSIS

Household technologies are adopted and used for reasons—their presence in the home is, in and of itself, not significant.[9] Rather, what matters is the use to which a technology is put and the consequences it has for individual family members; the family as a whole; and the home as a physical, emotional, and psychological space.

Several studies provide useful conceptual frameworks. Some focus on the role of information and information processing (Childers 1975); others on the overall adoption-use-impact process (Dutton, Rogers, and Jun 1987; and Venkatesh 1996); still others on the impact of IT on the family itself (Habib and Cornford 1996); and finally others on the quality of life impacts of home-based IT (Hesse et al. 1991). Taken together, these conceptual and theoretical models point to a few basic stylized elements regarding IT in the home:

- IT in the home performs three basic functions for family members: (1) interpersonal communication, (2) information acquisition and processing, and (3) entertainment.

- The adoption process for IT is distinctly different from the dynamics of IT use, and both sets of behaviors are strongly affected by socioeconomic, demographic, technological, and psychological factors.

- The household as a level of analysis is extremely complex. Impacts can reflect a variety of changes to individuals and the family in terms of both behavioral and emotional responses. Since the home itself also possesses tangible and affective attributes,[10] it represents a unique unit of analysis. Quality of life is another way of conceptualizing the impact of IT in the home.

Figure 1 is a graphical representation of an overall framework for making sense of the adoption, use, and impacts of home IT. The items organized in the figure are not meant to be exhaustive, but rather illustrative of the main ways in which scholars and analysts organize their thinking and research on home IT. If we envision each stage of activity as a dependent variable, it becomes obvious that the complexity of these phenomena increases as we move through successive social stages of innovative activity and responses. For example, home IT adoption is a relatively simple dichotomous behavior: a yes/no adoption choice allowing for early and late adopting behavior. Type of use is far more complex; as a dependent variable, it can be characterized by function, content, type of application, or time and scope of user activities.

Impacts are even more broadly understood, encompassing multiple levels of analysis (individual, family, home); a wide variety of quality of life indicators (physical safety and health; consumer benefits; leisure time and entertainment; educational attainment); and an array of psychological, behavioral, and sociological responses to the presence and use of IT in the home.

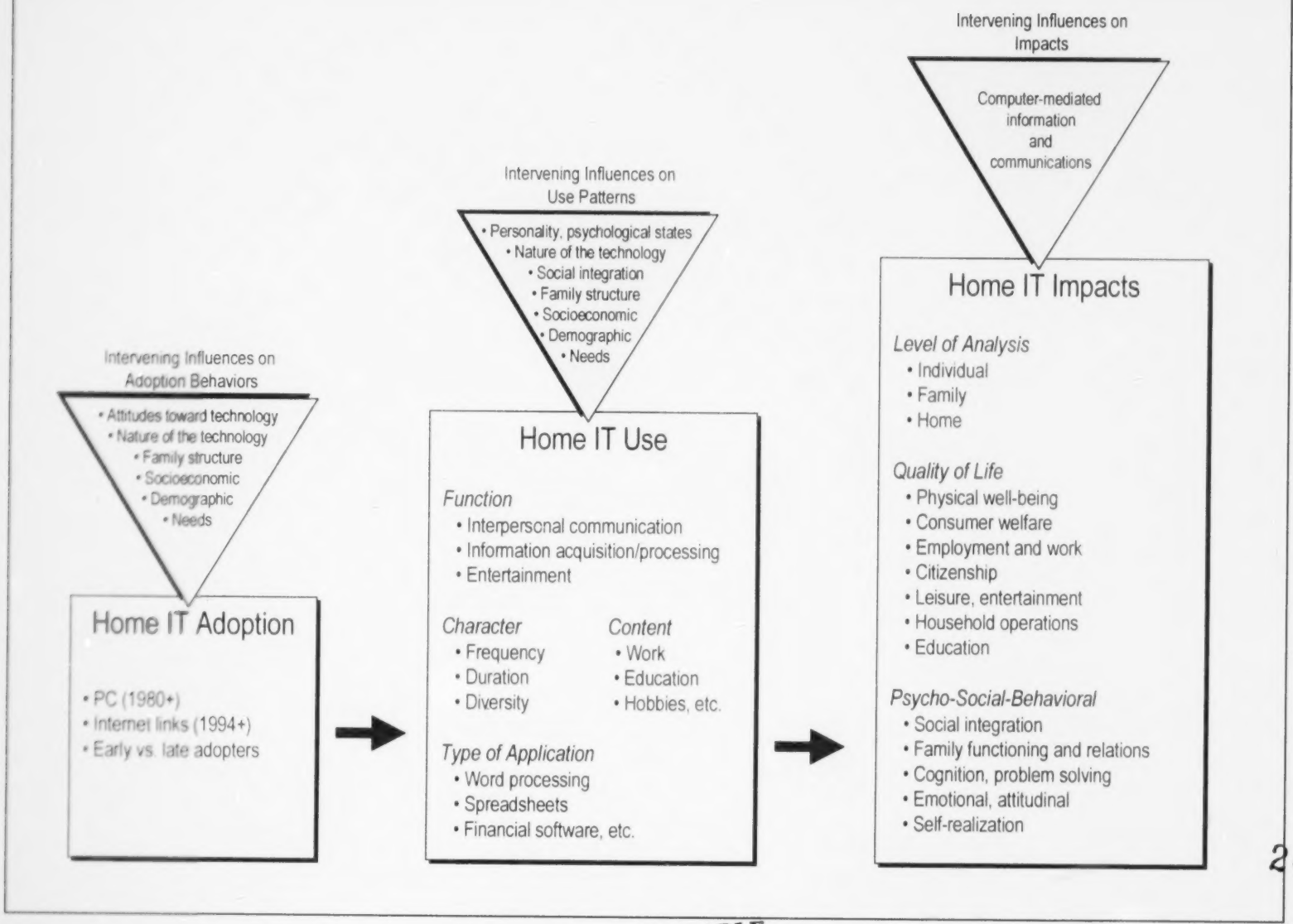
The driving concern in social impacts research is on the last stage of activity, particularly whether the consequences of a technological innovation are positive or harmful. In some instances, new technologies can be relatively benign (such as home appliances), notably beneficial (such as new medicines), or quite costly (such as nuclear power). Steinfeld, Dutton, and Kovaric (1989) highlight the fact that there is an unusual duality to the home impacts of IT. On the one hand, these technologies promise to enrich social networks, learning, education, information processing, and so on; on the other, they threaten to create (for example) more stress, overwork, and psychological and social isolation. There is no reason to expect that the consequences of home IT will necessarily be beneficial or damaging; it is far more likely that the consequences will be of both varieties, and the problem is that there is not enough research on either.

The following sections of this report discuss the research and findings on IT in the home as they parallel the three main stages of household innovation presented in figure 1: adoption, usage patterns, and impacts of use. Intervening variables are also discussed. For adoption and usage behaviors in particular, a fair amount of attention is given to socioeconomic and demographic influences. Research on impacts is quite sparse, and gives no real impression of the overall consequences of IT for the homes that use them.

[9]Not significant from a functional standpoint, that is; a technology can have an important symbolic presence in the home.

[10]A thoughtful discussion of the concept of "home" can be found in Nowotny (1981), particularly chapter 2. Nowotny notes that, in addition to its physical and aesthetic characteristics, the home is a space for intimacy, privacy, reproduction, and family relations and has historically served as a sanctuary from the outside world.

Figure 1. Framework for analyzing the adoption, use, and impacts of IT in the home



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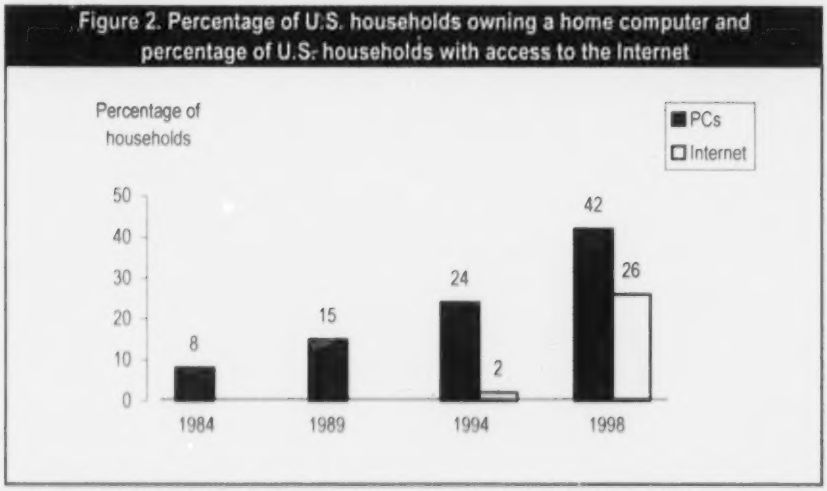
THE SOCIODEMOGRAPHICS OF ACCESS AND ADOPTION

TRENDS IN PC AND INTERNET ACCESS

Personal computers were commercially introduced in the late 1970s, and home Internet access became widely available to the general public around 1992–93. The earliest reliable data on PCs in the home is for 1984; for Internet access, it is for 1994.[11] Figure 2 shows trends in the adoption of home computers and access to the Internet in the United States. As can be seen, home ownership of PCs has grown rapidly, principally since 1994. During the 4-year interval from 1994–98, the percentage of households owning a home computer increased by 18-percentage points, twice the 9-percentage point increase for the 5-year period from 1989–94 and far greater than the 7-percent growth from 1984–89. Internet access has grown even more dramatically; the number of households connected to the Internet has risen from 2 percent of all households in 1994 to 26 percent in 1998.

Figure 2. Percentage of U.S. households owning a home computer and percentage of U.S. households with access to the Internet



SOURCES: All data are from the U.S. Bureau of the Census, except the 1994 Internet data point, which is from Clemente (1998).

The recent rapid growth in home adoption of IT masks considerable disparities in access by income levels, ethnicity, and geographic location. Using data from the Current Population Survey (CPS) conducted by the Census Bureau, the National Telecommunications and Information Administration (NTIA) found that the "digital divide" is worsening among Americans (NTIA 1995, 1998, and 1999). From 1994–98, the gap in PC ownership between white and black and Hispanic households widened, as did the gap between rich and poor. Although ownership of home computers and Internet access increased in all income and racial/ethnic categories during these 4 years, the disparity in ownership has widened. For example, in 1998, 46.6 percent of white households owned a home computer, compared to 23.2 percent of black households—a gap that increased by nearly 7-percentage points from 1994 (NTIA 1999). Notably, PC ownership is greatest for households of Asian/Pacific Islander heritage—55 percent of such homes own a PC.

These racial/ethnic differences cannot be accounted for solely by affluence: the CPS survey data indicate that within every income category, black households lag white households substantially in their adoption of home computers and linkage to the Internet, although the gap is not as large at higher income levels. NTIA (1999) reports that "The role of race or ethnic origin is highlighted when looking at similarly situated families. A white, two-parent household earning less that $35,000 is nearly *three times* as likely to have Internet access as a comparable black household and nearly *four times* as likely to have Internet access as Hispanic households in the same income category." Geographic location also has an impact on household PC ownership and Internet access beyond what can be predicted by income levels. Homes in rural areas are less likely to own PCs or be connected to the Internet even when income is held

[11] Data on Internet access for households do not necessarily reflect a constant subscription to the Internet. Households can sign up for Internet access and then subsequently drop or switch service providers. These data thus reflect snapshots of households connected to the Internet at the point in time when the survey was administered.

constant in statistical analyses (NTIA 1999). Certain groups thus appear to show consistently low levels of home IT access, particularly homes that are low income; black, Hispanic, or Native American; less educated; headed by single females; and located in the South, rural areas, or central cities.

Clemente (1998) is the only author to provide detailed data on trends in Internet access and the characteristics of Internet users. Based on data from the American Internet User Survey conducted by Cyber Dialogue, he finds that Internet use is strongly skewed toward male, well-educated, affluent individuals from knowledge-based occupations (this survey does not obtain data on race/ethnicity):

- Men represented 61 percent of Internet users in 1997 (although down from 78 percent in 1994).
- Forty-three percent of adults in Internet user households were college graduates, compared to 21 percent of the U.S. adult population.
- The average income of Internet user households in 1997 was $57,600, well above the national average of $44,900.
- Forty-seven percent of adults in Internet user households are knowledge workers compared to 27 percent for the general population, and far more household users are either self-employed or own their own home-based business compared to the general population.

Clemente notes a distinct trend toward broader representation on the Internet. Since 1994, users have become slightly older and less educated. They also represent a wider variety of occupations and are substantially less male.

Overall, the sociodemographic data on access to home computers and the Internet suggest that, in spite of the recent rapid diffusion and increased access to these technologies, notable inequities still exist. Some minorities,[12] the poor, and the less educated lag other social groups in terms of IT access and use; this gap appears to be widening rather than narrowing (NTIA 1995 and 1998). Although regional differences can be found, such as lower Internet connection rates in rural and inner city areas, these disparities disappear once socioeconomic factors are taken into account.

Determinants of IT Adoption

The literature on technological diffusion in households shows that there is a consistent socioeconomic (income, education, occupation) early adoption bias by individuals who are affluent, more highly educated, and from higher status occupations compared to society as a whole.[13] The data and research on home adoption of PCs and Internet linkages reinforce our existing understanding of early adopter patterns. In a study of home IT adoption among member countries, the Organisation for Economic Co-operation and Development (1998) reports that income is the most important differentiating factor with respect to household penetration rates of home computers—the R^2 for this association was .77. Income and other socioeconomic factors were identified as strong predictors of adoption in many studies, including those by Bruce (1988) on the adoption of teletext services in the early 1980s and by Riccobono (1986), Dickerson and Gentry (1983), McQuarrie (1989), and Novak and Hoffman (1998) on the adoption of home computers. The NTIA (1995, 1998) studies discussed above, as well as Clemente's (1998) findings on Internet households, substantiate the significant impacts of income, education, and occupation on PC ownership and on-line access. In a major review of the literature from 1980–87 on home IT diffusion and impacts, Dutton, Rogers, and Jun (1987) find that level of formal education is the "single variable most consistently associated with the adoption of computing" and that socioeconomic factors are regular predictors of home IT adoption. Twenty years' worth of research thus consistently demonstrates the core influence of socioeconomic factors on home IT adoption.

Demographic variables are also important. Novak and Hoffman (1998) and Hoffman, Novak, and Venkatesh (1998) find complex relationships between home IT access, race, income, and levels of education. In these studies, some racial lags in home IT access emerged that could not be accounted for by level of income or education. Differences in levels of home computer ownership between blacks and whites were statistically significant after controlling for level of educa-

[12]The CPS data reported by NTIA indicate that Asian/Pacific Islander households have higher levels of computer ownership than white households at all income levels.

[13]This pattern holds across all kinds of household products, technologies, and innovations. See Dickerson and Gentry (1983) and McQuarrie (1989) for a review of this literature.

tion, and income alone could not account for extreme disparities between white and black students with respect to computer ownership.[14] The NTIA studies also identify persistent differences among racial/ethnic groups that cannot be accounted for by level of income or education.

A few other factors are suggested by the empirical research as important influences on IT adoption dynamics. *Family structure* (marital status of head of household, presence of children in the household, age of the head of household) emerged in several studies as a differentiating factor for home PC and/or Internet access (NTIA 1998; Clemente 1998; Caron, Giroux, and Douzou 1989; Dutton, Rogers, and Jun 1987; and Venkatesh and Vitalari 1987). In general, families with children and married parents were more likely to adopt PCs or link to the Internet than single people, couples without children, single heads of household, or households headed by very young adults. (Income could be an intervening factor for these latter two family structures.) Also, individuals with *a positive attitude toward technology or computers* are, not surprisingly, more inclined to adopt PCs than are others (Gentry and Dickerson 1983; Dutton, Rogers, and Jun 1987; and Venkatesh and Vitalari 1987). Finally, there appears to be a *gender difference* in the decision to purchase a home computer. Several studies reported that the decision to buy a home computer was usually made by the male head of household, sometimes even over a wife's objections (Caron, Giroux, and Douzou 1989; Giacquinta, Bauer, and Levin 1993; and Dutton, Rogers, and Jun 1987).

[14]The authors found that 73 percent of white high school and college students owned a home computer, contrasted to 33 percent of black students.

Patterns of IT Use

Research and data on patterns of IT usage fall into two distinctly different groups: research conducted in the early to mid-1980s on the use of home computers, and research conducted in the mid-1990s on Internet use. There is thus a substantial gap in our understanding of how computers are used in the home. Not only do the empirical studies on PCs essentially reflect early adopters—a group of people who are known to be atypical of the general population—but they tend to be studies that, because of their research design, cannot be generalized to the overall population. And, as a study by the National Research Council (1997) points out, the software and user interfaces that we have today were designed for early typical uses. Jobs associated with these uses were held predominantly by white men. It has been suggested that this is intertwined with the many other psychocultural influences on adoption patterns. As a consequence, the findings for PC use should be regarded as *suggestive* (and certainly not as definitive)—they identify areas of potential research interest and analytical need.

This section of the report separates PC from Internet behaviors and addresses some distinctive differences by sex in the use of both computers and the Internet. No major works were identified that addressed (in detail) use and outcomes of different computing media, such as different software programs or the more recent CD-ROM resources.

Home Use of Personal Computers

Early adopters of home computers did not necessarily use their machines intensively. For example, Riccobono (1985) found that in a typical week, a sizable proportion of adults (40 percent) did not use their computer at all. In general, many households found that they were using the PC less than they expected; in Riccobono's national study, 43 percent of the adult computer owners surveyed indicated that they used their computers much less than they anticipated at the time of purchase. This finding is consistent with other research addressed in Dutton, Rogers, and Jun (1987); two studies discussed in their literature review indicated that 18 and 27 percent of the respondents used their computer less than they had initially expected. Giacquinta, Bauer, and Levin (1993) found that 70 percent of the family members in their 1984–86 study were either nonintensive users or nonusers of their home computers. Further, Venkatesh and Vitalari (1987) found that planned and actual use of home computers diverged. While the most frequently mentioned intended applications were for business and education, in reality, families tended to use their PCs more for word processing and games (which also reflects the availability of software at the time).[15]

Caron, Giroux, and Douzou (1989) reported in a longitudinal study of families with PCs that 18 percent had quit using their computer entirely after 2 years. Riccobono found that slightly over one-third of all age groups in his study used the computer 6 hours or more per week, a proportion comparable to that found for the children in the Giacquinta, Bauer, and Levin study but higher than they found for adults (only 25 percent were major users).[16]

These patterns of use were variable across family members, however. In the Riccobono study, only 16 to 20 percent of children aged 6–17 in the home did not use the computer at all in a typical week compared to 40 percent of the adults. While 45 percent of the parents were nonusers in the Giacquinta, Bauer, and Levin study, only 16 percent of the children were. Fathers tended to dominate use of the computer in the home (Caron, Giroux, and Douzou 1989; and Giacquinta, Bauer, and Levin 1993), and females tended to represent a higher proportion of nonusers across all age groups (Riccobono 1985; Giacquinta, Bauer, and Levin 1993).

Other factors also appear to influence frequency, intensity, and long-term computer use in the family. Dutton, Rogers, and Jun (1987) noted that computer users who become involved in a social (computing) network tended to use it for more hours each week and for a greater variety of applications. McQuarrie (1989) found that intensity and breadth of PC use was a function of the quality of the computing equipment in the household. Caron, Giroux, and Douzou (1989) reported that for families largely inexperienced with computers prior to purchase,

[15]For further analysis of computer use, see U.S. Census Bureau 1988 and 1989.

[16]Many factors could explain this difference in findings. To begin with, the Riccobono study was a national probability sample of several thousand households, and the amount of hours the computer was used per week was specifically quantified. The Giacquinta, Bauer, and Levin study, on the other hand, was a case study of 70 families, and "major use" of the computer was identified simply as frequent use for long periods of time.

sociodemographic variables were not good predictors of computing patterns in the home. Instead, families that had quit using their computer after 2 years had a naive approach to their computer purchase, high expectations for the technology, and tended to use the PC more for games and learning about the computer than other families. In contrast, families that sustained and even intensified their use of the PC over time had a much higher proportion of work-related use.

Evidence regarding the dominant content of PC use is mixed, and the research cannot be systematically summarized because of limited data, vastly different research designs, and different ways of presenting questions to survey respondents. The one theme that consistently emerges is the major role of education in PC use. The importance of educational uses of the computer tends to be referred to more often and in higher proportions by most studies than any other type of application (OECD 1998; and Dutton, Rogers, and Jun 1987). Other prominent uses appear to be games, word processing, and work-related tasks, as well as programming and learning about the computer (Riccobono 1985; Caron, Giroux, and Douzou 1989; OECD 1998; Dutton, Rogers, and Jun 1987; and Giacquinta, Bauer, and Levin 1993). The least frequently reported uses seem to be related to home operations.

Home Use of the Internet

Evidence related to home uses of the Internet is far more recent and far richer than that related to computer use. This research also tended to use data from national probability samples and can therefore be used to make some generalizations to the overall population. However, these data suggest relatively limited Internet use from the home: only 2 percent of American households had Internet access in 1994, and estimates for 1998 placed this figure at 26 percent (figure 2).

Clemente (1998) reported that Americans accessed the Internet primarily from home: 75 percent of Internet users accessed it from home, and 46 percent did so exclusively in 1997. Clemente attributed this shift from work- to home-based use since 1994 largely to the changing rate structures of Internet service providers—e.g., the introduction of flat-rate monthly fees. Novak and Hoffman (1998) found that not having access to the Internet from home inhibited Internet use. People who have Internet access at work but not at home were less likely to have used the Internet in the previous 6 months than those having on-line access at home exclusively or at both home and office. People with no access to the Internet at home or in the office were not at all likely to have used the Internet in the previous 6 months except at higher income levels, suggesting that alternative public locations for use (e.g., libraries and schools) were not exploited by Americans without on-line access.

In 1997, Internet households tended to spend about 8 hours on-line per week; most (41 percent) accessed the Internet between 6 and 10 p.m. (Clemente 1998). Here too, patterns of use can vary widely by family members. For example, Kraut et al. (1996) reported that "the median teenage boy used the Internet at least once per week during 43 of the first 55 weeks [of the HomeNet field trial] and logged 320 hours of connect time. The median adult male accessed the Internet only 20 out of the 55 weeks and logged less than 32 hours of connect time." For 85 percent of the families in this study, the heaviest Internet user was a child.

The HomeNet study is an interesting one because of its research design. It is not a probability sample so it cannot be generalized to the U.S. population, but it is relatively unique in using time diaries and actual electronic computer logs to study how people spend time on the Internet. In addition, traditional socioeconomic barriers to household access to PCs and the Internet are removed by virtue of the study's design: families were given a subsidized home computer, free Internet service, and training on computer and Internet use. After extensive statistical analysis, Kraut et al. (1996) concluded that "Neither household income nor education predicted Internet use, strongly suggesting that if economic barriers were removed, people across socioeconomic lines would use the Internet."

The authors did find, however, that race, sex, and generational differences were all strong predictors of Internet use: teen males were heavier users than teen females, whites were likely to use the Internet more than minorities, men more than women, and teens more than adults. The single strongest predictor of Internet use was the generational variable—teens versus adults. Kraut et al. found that after controlling for these demographic factors, all other potential influences on Internet behavior became statistically insignificant. They analyzed the impact of psychological states (depression, social extroversion, and innovativeness); the amount of "hassles" people experienced on a day-to-day basis;

computing experience and attitudes; and the use of traditional media. In related HomeNet research, Kraut, Mukhopadhyay et al. (1998) found that individuals who rate themselves as having strong computer skills are the heaviest users of the Internet.

E-mail and World Wide Web activity dominate home Internet use; in general, it appears that e-mail may be the more important activity. In their study of HomeNet families, Kraut, Mukhopadhyay et al. (1998) found from computer logs that people used e-mail more frequently than the Web and that they used e-mail first in on-line sessions that included both e-mail and Web activity. Indeed, people who used e-mail more than the Web were more likely to continue using the Internet over the course of a year than people making greater use of the Web.

How people use the Web is both idiosyncratic and generalizable. For example, Kraut et al. (1996) found that the websites visited by HomeNet family members were unique to the individual. Of the roughly 10,000 unique addresses visited during the study, 55 percent were accessed by only one person, and fewer than 2 percent were visited by 20 percent or more of the individuals in the sample (these tended to be search engines and Web portals).

Usage is nonetheless patterned by broad categories. In terms of general information searches, the American Internet User Survey reveals that health and medicine is the most popular Internet subject. Thirty-six percent of all users and 47 percent of women reported exploring this subject; other major areas of interest included entertainment, music, parenting/children, and lifestyles subjects.[17] NTIA (1999) found distinctive patterns of home Internet use based on purpose. In general, individuals with higher income and education levels were far more likely to use the Internet for work-related activities, while minorities and unemployed individuals used the Internet for employment searches and to take educational courses. Clemente (1998) found an increase in on-line purchasing—about 27 percent of 1997 Internet users made on-line purchases the previous year, compared to 19 percent at the end of 1995. Clemente also cited the following patterns in the kinds of information sought by Internet users:

- As age increases, so does interest in Internet information related to news, travel, government/community, health and medicine, product information, and personal investing.
- Women tend to seek information related to travel, health and medicine, food, and parenting more than men.
- High-income individuals are peak users of travel, product information, sports, and investment information.
- Low-income individuals are peak users of hobby, community, music, game, adult education, and parenting information. NTIA (1995) found that low-income households were more likely to use the Internet for employment purposes, education, and accessing government reports than other households.

Katz and Aspden (1997) conducted one of the few studies that addressed Internet use related to social integration. In a random digit dial survey of 2,500 respondents, these authors found that after controlling for demographic differences between groups (age, sex, education, race, and income), there were no statistically significant differences in the degree to which Internet users were members of religious, leisure, or community organizations compared to nonusers. In addition, the authors found that the vast majority of Internet users (both recent and long term) reported no change in the amount of time spent with family and friends on the phone or through face-to-face contact. Interestingly, the data indicate that long-term Internet users belong to more community organizations than any other group (nonusers, former users, etc.), suggesting that there may be people who are simply more "connection oriented" than others.

Hill and Hughes (1998) explored social integration by focusing on individuals they call "Internet activists." Using data from the Pew Research Center for the People and the Press, Hill and Hughes examined individuals who reported that they either "chatted" about politics on the Internet or posted political messages to newsgroups, bulletin boards, and so forth. About 18 percent of Internet users in 1995–96 could be considered Internet activists, and the authors found statistically significant differences between this group of people, the general public, and Internet users who did not use the Internet for political activity. Hill and Hughes found that Internet activists were generally younger than the other two groups and also substantially tended to be male and better educated.

[17] Data from the American Internet User Survey, accessed August 19, 1999, Cyber Dialogue <www.cyberdialogie.com/free_data/index.html>

Internet activists were also less likely to be white than the general public and other Internet users, an unusual result given the predominant demographics of Internet users. Internet activists also identified less with the Republican party than the general public and were more tolerant with respect to certain civil liberties. (They were less likely to oppose book burning, homosexuality, or pornography.) They were no different than the general public, however, with respect to such issues as assisting the needy, attitudes toward regulating business, or the strength of their political party identification.

Gender Differences

One of the most persistent differences in computer and Internet use relates to gender. Several studies point to the dominance of men in household decision-making about home computer purchases (Caron, Giroux, and Douzou 1989; Giacquinta, Bauer, and Levin 1993; and Vitalari, Venkatesh, and Gronhaug 1985), and the extensive case research conducted by Giacquinta, Bauer, and Levin highlighted the limited role of women in household computing dynamics. Mothers in this study were not only far less likely to be major users of the home computer compared to the fathers (9 percent versus 43 percent, respectively), but when women *were* major users, their husbands and sons still viewed them as indifferent and unskilled with respect to the PC.

Both the Caron, Giroux, and Douzou research and Giacquinta, Bauer, and Levin study suggest that computer use by fathers displaced access by other family members. In both studies, survey data and field logs indicated that the home computer was located or used in a way that prevented other family members, particularly wives and daughters, access to the machines. In the Caron, Giroux, and Douzou study, when a second PC was brought into the home, the amount of time spent on the computer by mothers and children was appreciably higher than in households with only one machine. In his study of educational uses of the home computer, Riccobono (1985) also finds "clearcut sex differences" in every age group. Males were substantially more likely to use a computer and to use it for more hours than women; 55 percent of adult women reported not using the computer at all in a typical week, compared to 27 percent of men.

The tendency for men to use on-line services more often and for longer periods was identified by Clemente (1998); by Kraut et al. (1996); by Kraut, Mukhopadhyay et al. (1998); and by Bruce (1988) in her analysis of teletext services in the early 1980s. Clemente also found differences between the sexes in the types of Internet content accessed. In a qualitative discussion about what women appeared to want from on-line services, Clemente concluded that, at least in the mid-1990s, the Internet simply did not have what women wanted and needed.[18] Giacquinta, Bauer, and Levin concluded much the same for the limited participation of women in early home computing: "Clearly for the majority of these women, the design, marketing, and interpretation of home computer hardware and software did not address their needs or the reality of their lives. Mothers view time in the home very differently, time required to master computer activities is a burden rather than an escape or pastime" (1993, p. 90).

Educational Use of Computers

The one use of home computers most consistently and strongly detected in the empirical research relates to the importance of home computing for educational purposes. Two studies, both more than 10 years old, examined the use of home computers for education and informal learning. Riccobono (1986) reported the results of the Home Information Technology Survey (HITS), a national random digit dial survey fielded in early 1985 on the availability of personal computers in the home and their use for educational purposes. Giacquinta, Bauer, and Levin (1993) reported the results of a qualitative study of 70 families from 1984–86 related to how children used computers at home.

Conducted by the Department of Education, HITS was designed to provide a national picture of out-of-school (informal) learning activities by Americans and the types of learning resources they used. Riccobono (1986) summarized the HITS findings and addressed the availability of IT in the home and its use for education and learning. IT was broadly defined and included print, audio, video, and computer technologies; learning was differentiated as practical/recreational (hobby-related, for example) and intellectual (acquiring skills and knowledge for their own sake). Survey questions distinguished behaviors of household members by age: children 2–5 years old, children 6–11 years; children 12–17 years, and adults (18 years and older). The data were adjusted and weighted to be statistically representative of the U.S. population.[19]

[18]See particularly his discussion on pp. 57–60.

[19]Findings cannot be generalized to elderly or low-income populations, however, because of bias in the random digit dial method used for this study.

Riccobono reported several findings related to PC use for educational purposes:

- When computers were available,[20] they were more likely to be used for learning by children than by adults.
- Computers were almost three times more likely to be used for intellectual rather than recreational learning for all age groups.
- Seventy-two percent of adult respondents indicated that computer games and programs were "not helpful" to their learning activities; just over half of the children aged 6–17 indicated the same lack of helpfulness.
- Individuals who preferred to study alone or at their own pace were slightly more likely to use computers for learning compared to those who liked to study in a group or in a more structured environment.

Conducted over the same time period (1984–86), Giacquinta, Bauer, and Levin's study was essentially a collection of 70 case studies on home computing. White middle and upper class households from the New York City tri-state area were studied for 4 months; fieldworkers made 6–10 visits to a family of 1–3 hours per visit and recorded data in a field log. The logs were then subjected to content analysis. The authors reported a "near absence" of children's academic computing—that is, computing for the purpose of learning school subjects and critical thinking. Game playing consumed most of the children's time on the computer. Interestingly, the authors found that children (or their families) were discouraged from using or talking about their computers because of negative social pressures from teachers or neighbors. Overall, they found a complex set of interrelated factors that influence a child's academic computing efforts at home, including school emphasis, parental support, availability of academic software at home, early computing experiences, and peer and sibling support.

More recent data on children's use of computers tends to reinforce the findings from these older studies. The National Center for Education Statistics reported that, at least for fourth and eighth graders, playing games was the most common computing activity (NCES 1998). Nearly 90 percent of all children in these grades used their computer at home (or at school)[21] for this reason. However, 80 percent or more of students also reported using the computer "to learn things," and 96 percent of 11th graders used the computer to write stories or papers (these data are from 1996). The overall impression from the data is that at the grade levels surveyed, students used the computer to play, learn, and write in overwhelming proportions and that no one application dominated computer use.[22]

[20]As a reminder, this study found that 13 percent of all adults in U.S. households had access to a home computer, as did about 20 percent of children aged 6–17. Riccobono cautions that the influence of technology should consequently not be overstated for out-of-school learning. Not only did he find that "substantial numbers of learners within each age group made no use of any technology in their learning," but "adults who use no technology were likely to be more satisfied with their learning than adults who used some form of technology" (Riccobono 1986, p. 11).

[21]Note that the NCES data do not differentiate between student use of the computer at home or school.

[22]For more current studies that were not available at the time this report was prepared, see NCES (1999a, 1999b, 2000).

RESEARCH ON IMPACTS

True home IT impact assessments—for example, those that focus on family dynamics, individual outcomes, quality of life enhancements (or dimunitions), and behavioral changes—are scarce. Five categories of impact research were identified and are addressed here:

- time displacement studies,
- the impacts of teleworking on the home,
- psychological well-being,
- informatics and healthcare, and
- the impact of video games on children.

Even within these categories, the amount of research conducted is extremely modest, and an important dimension of impacts and outcomes—the intervening effects of computer-mediated communication on behavior—is not addressed in this research.[23]

TIME DISPLACEMENT STUDIES

Time displacement studies assess the degree to which the introduction of a new technology in a household affects patterns of time use and allocation. Such studies have been done, for example, with respect to vacuum cleaners, automobiles, televisions, and microwave ovens, among other technologies. Three time displacement studies have been conducted with respect to home computing. Two focus on the impacts of home computing and the Internet on the use of traditional news media (newspapers, television, radio, books, and magazines); the other explores how individuals reallocate their time once home computers are brought into the household.[24]

To determine whether use of the Internet and home computers displaces use of traditional news media, Robinson, Barth, and Kohut (1997) analyzed 1994 and 1995 survey data from the Pew Research Center for the People and the Press on IT in the home that show when and how often individuals use different kinds of media. Although they found a variety of correlations, few were statistically significant, of meaningful magnitude, or represented a clear pattern that could not be accounted for by socioeconomic factors. In general, however, the authors found that IT use in the home was associated with a higher use of traditional news media, not lower. They concluded that IT may therefore be media enhancing; it is also possible that home IT users may generally be more "news seeking" than non-IT users. Coffey and Stipp (1997) also found little media displacement between television and PC activity. Using data from PC Meter (a commercial marketing service), they noted indications that use of one medium (the PC, the Internet, and television) tended to reinforce use of the others.

Clemente (1998) analyzed data from the American Internet User Survey conducted by Cyber Dialogue and found patterns of media displacement that tended to support the Robinson, Barth, and Kohut findings. In this study, about one-third of all Internet user households reported that they watched less television, although this displacement tended to be slightly higher for recent adopters than those who had been using the Internet for a year or more. These latter households reported relatively low (from 10–13 percent) declines in reading newspapers, books, or magazines and in listening to the radio.

Vitalari, Venkatesh, and Gronhaug (1985) cast a broader eye on the time allocation impacts of home computing. In a nonprobability study of 282 members of computer clubs in Orange County, California, the authors assessed the impact of computing on 10 household activities: watching television, reading, leisure time spent with family, leisure time spent with friends, outdoor recreation, sports, hobbies, sleeping, time spent alone, and studying/doing homework. Notably, 96 percent of the respondents were men; this, as well as other factors (the majority of respondents had previous experience with computers and also worked in technical professions), make this sample a particularly nonrepresen-

[23]The influence of computer-mediated communication (i.e., communication such as e-mail that occurs via computer) as an intervening factor on social impacts is an important one; but it is outside the scope of this integrated overview. For useful examples of this research, see Parks and Floyd (1995) and Hiltz and Turoff (1993).

[24]Note that time displacement studies are different from simple time allocation studies and diaries. Time displacement research focuses on how the adoption and use of one technology replaces the use of other technologies or reorients household activities; time allocation studies and diaries are simply an accounting of the distribution of household work and activity over the course of a day or week. A major resource for information on time allocation patterns in the home is the University of Michigan's Panel Study of Income Dynamics household time use data <http://isr.umich.edu/src/psid/index.html>. Although these time use diaries do not include time spent on computing or the Internet, it may be possible to couple these datasets with others that do.

tative group of respondents.[25] Major shifts (e.g., more than 20 percent of respondents reported the change) were detected with respect to decreased television watching, outdoor recreation, hobbies, and sleeping; and increases in time spent alone and studying. (Note that these latter two are not mutually exclusive.) The greatest shifts in time allocation patterns were reported in families with children, suggesting that such households are particularly sensitive to the introduction and presence of a computer.

IT, Work, and Home

Teleworking has long been hailed as one of the major social benefits of IT. By enabling individuals to stay home and work, whether by telecommuting to a parent office or establishing a home-based business, the relocation of work to home is believed to offer multiple advantages to individuals and families. Flexible work hours, lower household costs, less stress from family-work conflicts, and reduced commuting times are among the perceived benefits of computer-based work at home.

The vast majority of the research that has been done to date on teleworking only addresses the economic benefits of these arrangements to parent companies. Impact research on telework similarly focuses on productivity, job satisfaction, work attitudes, job stress, overwork, and employee turnover. Little research has been conducted that focuses on teleworking's impact on home and family life—a deficiency observed by Habib and Cornford (1996), who identify several key areas of concern: the impact on rules, norms, and roles in the household; the blurring of spatial boundaries between home and office; and the disruption of time patterns in family routines. Gurstein's (1991) research on 45 homeworkers echoes similar concerns. Her research indicates that IT homeworkers express guilt at neglecting their families, discomfort with the loss of their home as a "refuge" from work, and a sense of isolation and of being devalued by their office colleagues. Gurstein concludes that home-based computer work "results in role conflicts, inadequate workspaces, the blurring of the work/leisure time division, and the tendency for 'overwork' to occur" (p. 177).

In contrast, Riley and McCloskey (1996) found that limited use of teleworking arrangements may have positive home impacts. Reporting on a pilot program in which GTE Corporation allowed managerial employees to work at home 1 day a week for 6 months, the authors found that "Of the 120 participants in the telecommuting pilot study, 75 percent reported increased feelings of satisfaction with their home life [and] 44 percent reported having more quality time with the family" (p. 87).

These telework studies generally predate widespread access to the World Wide Web and major changes in distributed work arrangements in the private sector. Consequently, they may not reflect the variety of household impacts that come from less insulated work systems. Nonetheless, these studies are suggestive of a common theme in the theoretical and philosophical literature on IT, namely the duality of IT impacts. On the one hand, teleworking can potentially enhance people's ability to better balance work and family needs and reduce personal stress. On the other, home-based IT work can potentially disrupt crucial family dynamics (roles, interpersonal relationships, and the sense of home as a sanctuary) and create psychological isolation and low self-esteem. The extremely limited research presented here suggests that it is not telework per se that can be damaging, but the degree and intensity of its presence in the home.

Psychological Well-Being[26]

As with so many other potential impacts of IT in the home, the influence of computing on the psychological well-being of individuals may be beneficial or harmful. Greater connectedness to a community, ease of communication with family and friends, and improved access to information can enhance self-worth, feelings of satisfaction, a sense of community and kinship, and personal empowerment. Scholars express concern, however, for the "dark side" of computing: isolation, growing social insularity, and—increasingly—"Internet addiction." Although a body of psychobehavioral work exists with respect to computer-human interactions and computer-mediated communication, three empirical works stand out with respect to the psychobehavioral impacts of Internet use. These relate to Internet addiction, social integration, and loneliness and depression.

Although the existence of Internet addiction as a clinical disorder is still in dispute, a number of profes-

[25]In addition, respondents are early adopters of home computers. As others have shown (e.g., Dutton, Rogers, and Jun 1987), such early adopters are atypical of the general population in a variety of ways.

[26]Important, qualitative case study research exists on the psychological impacts of computing. Seminal works in this area are by Turkle (1984 and 1995); also see Vitalari and Venkatesh (1987) for a conceptual treatment of the psychological dimensions of in-home computing technology and information services.

sionals unequivocally assert that it is a real phenomenon.[27] Egger and Rauterberg (1996) explored data on whether heavy Internet use reflects addictive behavior; their data were obtained from an on-line survey posted and advertised on the World Wide Web. Roughly 450 valid survey responses were received, largely from Swiss and American respondents.[28] Although the findings of the survey cannot be generalized beyond the sample, the key findings are suggestive for future research. First, 10 percent of respondents *perceived* themselves as Internet addicts or dependent upon the Internet, and objective measures of addiction were, on the whole, statistically significant for this group. Second, this small group of Internet addicts represented all walks of life. There were no statistically significant demographic differences between people who could be considered Internet addicts and those who did not—this group could not be differentiated by sex, age, nationality, or living situation.

Concerns that Internet users may be socially withdrawn from their communities were not substantiated by research reported by Katz and Aspden (1997). These authors found—as reported above in the section on Internet use—that, after controlling for demographic differences between groups (age, sex, education, race, and income), there were no statistically significant differences in the degree to which Internet users were members of religious, leisure, or community organizations compared to nonusers. They also found that the vast majority of Internet users (both recent and long term) reported no change in the amount of time spent with family and friends on the phone or in face-to-face contact. Further, the data indicate that long-term Internet users belonged to more community organizations than any other group (nonusers, former users, etc.).

Kraut, Lundmark et al. (1998) found evidence, on the other hand, that greater use of the Internet was not only associated with increased social disconnectedness, but with loneliness and depression as well. Using data from the HomeNet study, these authors found that greater use of the Internet was associated with (1) "small but statistically significant declines" in social integration as reflected by family communication and the size of the individual's social network, (2) self-reported loneliness, and (3) increased depression. These correlations held even after controlling for initial states of loneliness, social involvement, Internet use, depression, stress, and so forth. The authors argue that their methods and findings indicate a *causal* relationship between increased Internet usage, declining social involvement, and worsening psychological states. However, the data cannot establish causality, but can reveal important statistical associations.[29]

Informatics and Healthcare

Patient health informatics are an emerging class of tools designed to help individuals understand their medical conditions and participate more effectively in decisions about treatment and care. Although these tools can be such basic "paper" products as brochures and letters, new interactive electronic media (computerized software and Internet resources) bring IT-based health informatics into the home. The potential quality of life impacts of health informatics for individuals and their families are considerable. But as Hersey, Matheson, and Lohr (1997) discuss, very few assessments of the effectiveness of these tools, both on their own and relative to other media, have been conducted. In their comprehensive review of the literature on the impacts of health informatics on patients, these authors identify only three studies related to the effects of interactive computer-based informatic tools. In all three studies, users of these tools demonstrated substantially higher levels of understanding about their medical conditions and/or treatment choices compared to those who did not use these tools.

Children and Video Games

Although the focus of this integrated overview is on computing technologies and applications, research on the impacts of video games on children is insightful. Not only are video games a form of information technology, but, given the popularity of computer games for children (National Center for Education Statistics data indicated that 80–90 percent of students used the computer for games; NCES 1998), there may be direct implications of video research for computer game behaviors.

This body of research is mixed, like so much of the other assessments of the psychosocial impacts of IT.

[27]See, for example, Young (1998).

[28]The authors were from Switzerland; most of the respondents were Swiss. The survey was posted in both English and German.

[29]The Kraut, Lundmark et al. study does not account for environmental conditions known to trigger social withdrawal and depression (such as loss of a job or marital conflict). Because it does not allow for intervening environmental variables, it ignores the possibility that greater Internet use could be the *consequence* of depression, loneliness, and social withdrawal caused by other factors.

Evidence is found for both positive and negative behaviors associated with the use of video games. There is also evidence of neutral outcomes: these games do not necessarily have any observable effect on children. For example, video game playing does not necessarily make children less sociable (Wiegman and van Schie 1998), but it may encourage them to spend less time on homework, may be addictive for a number of children (just under 10 percent), and may lead them to be more aggressive toward others (Phillips et al. 1995, and Wiegman and van Schie 1998). Video games appear to be more intellectually challenging and stimulating than television, and even though playing video games alone increases with age, children are more engaged with their families and friends when they do play with others (Kubey and Larson 1990). Of greater cause for concern is the strong preference of boys for more aggressive video games, and for these preferences to be associated with more aggressive behavior and reduced sociability (Funk 1993, and Wiegman and van Schie 1998).

Conclusion: Knowledge and Inquiry Gaps

Twenty years after the advent of the personal computer, we have a relatively clear picture of who has access to home computers and, more recently, to the Internet. The patterns of IT diffusion and adoption clearly suggest that IT is still very much a resource acquired by more affluent and well-educated Americans. Although PCs have been diffusing rapidly in recent years, they are diffusing more slowly into poor and minority households, and the research on both PC and Internet adoption behaviors indicates that socioeconomic and demographic factors continue to be the primary predictors of home IT access. Very simply, income allows families to hurdle affordability barriers to adoption, and well-educated individuals are more likely to be aware of and appreciate the ways IT can be used in the home.

The picture is a bit less clear with respect to usage patterns. Empirical research on home computing dates from the early to mid-1980s. This early adopter research suggests that the primary use of home computing was for education, play, work, and basic word processing; findings generally suggested that children tended to use home PCs more often and for longer periods than adults. Strong differences by sex appeared in some studies. Women and girls overall seemed to use the computer less often and less intensively than their male counterparts, and were much less likely to be heavy users of the technology. Sizable proportions of early adopters found that they used the computer less than they had initially expected, and, in one long-term study, nearly one-fifth of families had quit using the PC entirely within 2 years. It is not clear whether this underutilization of the home computer was due to the inability of the technology to meet needs within the family, the relative lack of quality software for the early computers, or other factors.

More recent research on Internet use reinforces some of the impressions generated by the early computing studies. Children and male teenagers still tended to be the heaviest users of IT. The Internet has made a new form of interpersonal communication available to households, and several analyses suggested that e-mail and communication drive use of the Internet by individuals and households. Specific informational content derived from the Web was relatively unique to each individual's interests and needs, but broad patterns of information use emerged. Americans most often sought information related to health and leisure. Affluent and educated individuals also used the Internet for work, while socioeconomically disadvantaged groups used the Internet to seek jobs and take classes.

Many studies pointed to the profound role of socioeconomic and demographic variables as predictors of use. Several interesting patterns of differential use of home IT simply disappeared once income, education, sex, and race/ethnicity were accounted for. For example, regional variations, the degree of involvement with community organizations, use of other media, daily "hassles," depression, innovativeness, computing experiences and attitudes,[10] and social integration seemed to be associated with home IT adoption and use behaviors, but were not statistically significant once the role of sociodemographics was introduced. As with adoption dynamics, sex, race, and ethnicity emerged in several studies as important correlates of IT usage patterns.

What we do not know about impacts is substantial. How do families and individuals use information gained from the Web and with what consequences? What are the outcomes of the growing role of e-mail in some families' lives? Are they any better off than families without e-mail? Do PCs meet the needs and desires of those in the home, or will the recent rush to purchase computers lead to disappointment and abandonment (again) by families with naive hopes for the technology and overly high expectations? Does the personal computer have any greater role and purpose as a family tool than it had 20 years ago? How does the presence of home computing affect family dynamics and relationships? Does it diminish or enhance quality of life, and under what circumstances? Are there pathologies associated with extensive Internet use? How does computer-based work at home affect the nature of home itself?

Least understood is whether the socioeconomic inequities that exist in access to home information technologies matter, and how. The implicit assumption is that the absence of IT in the home perpetuates social

[10]The lack of statistical significance for computing experience and attitudinal variables—once sociodemographic factors have been controlled for—may seem surprising and counter-intuitive. However, people with computing experience tend to be male, white-collar professionals, as are those with strong positive attitudes toward new technologies. Note that these findings are based on the early adopter studies, in which early adopters tend to be affluent, professional men with access to computers at work and an inclination to be the "first" to buy a new technology.

and economic disadvantages: individuals and families cannot build the computing skills needed in today's labor force, important educational resources cannot be accessed, and information needs go unaddressed. Even before the internet, Childers (1975) created a vivid portrait of how minorities, the chronically poor, and other groups in American society were informationally disadvantaged. These groups tended to have fewer lines of access to information, the quality and accuracy of their information was low, and their information networks were simply less enriching than those available to the rest of society. Those deprived of quality information suffer from compromised decision-making and problem solving related to their quality of life and well-being. Can home IT remedy these disadvantages?

Some of our knowledge and inquiry gaps can be filled with existing data resources. The CPS data and the Pew Research Center data are both publicly available and contain rich detail on home IT adoption, use, and sociodemographics. The Pew and CPS data can be used to address more detailed questions related to home IT adoption and use; it would be helpful too if these surveys contained items concerning the possible impacts and outcomes of home IT use.

Other knowledge and inquiry gaps will be hard to fill. Impact research, when properly conducted, is labor intensive, expensive, and time consuming. Such analysis will not occur without major funding by government agencies, industry, and foundations. There are many areas for fruitful impact analysis. Family dynamics, the consequences of health informatics, the outcomes of home computing for learning and educational success, quality of life improvements for low-income families that have adopted a computer, and the impacts of computer-based work at home are all areas of concern. Knowledge of such outcomes can ideally contribute to more effective IT management in the home and more positive outcomes for families and households.

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APPENDIX A. DATA RESOURCES ON IT IN THE HOME

THE DATASET INVENTORY

The dataset inventory was assembled from a variety of sources, primarily the World Wide Web (WWW), since most IT-related resources tend to have a substantial Web presence. In addition, several staff members of the Graphics, Visualization, and Usability (GVU) Center at Georgia Tech, who are responsible for GVU's WWW User Survey, were interviewed. GVU has researched and placed links on their Web page to many of the survey and data collection activities about computers and the Internet.

AVAILABILITY OF DATA RESOURCES

There are few data resources that meet the standards established for inclusion. To be included, data resources had to have a primary focus on technology acquisition and use by individuals or households and meet three criteria:

1. Data on information technology in the home had to be obtained through valid research methods.

2. Data had to be obtained from samples of the entire U.S. population.

3. More than 1 year of comparable data had to be available.

Eight data resources meet these criteria.[1]

At the outset, 20 potential sources of data on IT in the home were identified. Virtually all proved nonviable, however. Most were excluded because they did not provide—or no longer provided—data related to the scope of this project. Scholarly studies based on empirical research (typically one-time studies) were not included among the data resources, but are covered in the annotated works in Appendix B to this report.

Six organizations provide the data resources identified in the data inventory. The six organizations are:

- CommerceNet (commercial),
- Cyber Dialogue (commercial),
- International Data Corporation (commercial),
- Graphics, Visualization, and Usability Center at Georgia Tech (academic),
- The Pew Research Center for the People and the Press (not-for-profit), and
- U.S. Bureau of the Census (Federal Government).

Data from the last three organizations are available for free or for a nominal charge. The other organizations are commercial, for-profit market research firms.[2] This commercial dimension has implications both regarding the accessibility of data by scholars and other analysts (since prices can be as much as $10,000 for a single year's worth of data), and the ability to disseminate these data in the public domain. Because the commercial data are proprietary, their use is restricted even for subscribers.

TYPES OF DATA

Few data, if any, on the actual *impacts* of IT on the home are available. The metrics existing reflect diffusion indicators and are related to computer ownership/usage and Internet access/usage. Each data resource has a set of keywords included in its record that reflect the types of data available. These keywords and a description of each are presented in table A-1.

Note that many of the surveys from which the data are obtained differentiate between *business* and *personal* use of the computer/Internet but not between *home* use and use at *other* locations (work, school, library, etc.). Consequently, some data resources will not support analysis strictly limited to the use of IT in the home itself.

[1]One data resource was excluded because it focused on an individual state. This was the Research Institute for Telecommunications and Information Marketing (RITIM) at the University of Rhode Island. The RITIM data were based on a one-time survey of 1,500 households in Rhode Island. Study descriptions suggest that these data are similar to national data obtained by other organizations. For more information on the RITIM study, see http://ritim.cba.uri.edu/risurvey.

[2]Three other commercial research firms are frequently mentioned as sources of data on IT in the home: the NPD Group <http://www.npd.com>, PC Meter, and Media Metrix <http://www.mediametrix.com>. These organizations are not included here as data resources because no descriptions of the data and methods for their IT market research could be located. Also, the data product descriptions from these organizations suggest that their commercial packages reflect audience behaviors at specific websites and individual clickstream patterns. PC Meter merged with Media Metrix and is a data collection service that meters PC and Internet use much the way Nielsen meters television usage. A description of PC Meter may be found in Coffey and Stipp (1997).

The Internet Meta-Sites

For analysts interested in statistics, data, and trends related to the use of the Internet, two Internet meta-sites offer a good starting point. These Web pages contain dozens of summaries and links to reports and studies of the Internet. The organizations that sponsor these sites do not conduct primary research of their own; rather, they serve as resources for information about the Internet. The two sites are:

- CyberAtlas http://www.cyberatlas.com, and
- Nua Internet Surveys http://www.nua.ie/surveys/index.cgi.

The remainder of this appendix consists of fact sheets summarizing the 8 datasets and 2 meta-sites.

Table A1. IT in the home data resources: keyword glossary

Keyword	Description
General diffusion indicators	
Computer ownership	Computer ownership and access, technological features of home computers
Computer usage	Who uses computer, how frequently, how long, for what purposes
Demographics	Age, sex, ethnicity, income, education level, geographic region of users
Internet access	Access and location of access to the Internet
Internet usage	Who uses Internet, how frequently, how long, for what purposes
Subjects addressed	
Business usage	Types of business use for home businesses and home offices (accounting, finance, etc.)
Citizenship	Types of use related to citizenship activities: political speech and communication, use of Internet to gather political information, use of Internet to interact with government agencies, etc.
Culture & values	Attitudes toward role of the Internet on relationships, values, etc.
Education	Use for formal educational purposes: homework, continuing education, distance learning, degree programs, etc.
E-mail	Multiple dimensions of e-mail use (to whom, how often, etc.)
Employment & work	Use for employment and work purposes: job hunting, telecommuting, etc.
Entertainment	Use for games, travel, leisure, virtual museums, etc.
Health	Use for personal health and medical purposes
Legal & insurance	Use for personal legal and insurance purposes
Other	Use of chatrooms, telnet, ftp, and other types of Internet activities
Personal finance	Use for personal banking, credit, and finance purposes
Privacy	Activities and attitudes related to information privacy and security
Shopping	Use for personal shopping on the Internet

COMMERCENET/NIELSEN INTERNET DEMOGRAPHIC SURVEY

Abstract: Survey focus is explicitly and exclusively on uses of the Internet. Data are obtained semiannually through telephone surveys. Over 100 distinct questionnaire items explore Internet access and usage. Internet usage data cannot necessarily be isolated to the home; questions related to e-mail, personal business and finance, and other on-line activities do not always differentiate between home, work, or other access locations. CommerceNet is a commercial, for-profit market research organization.

Time Period: Survey conducted semiannually since 1995.

Availability: Data are available to subscribers through an on-line database called Gideon http://www.commerce.net/research/gideon. Most metrics are available as population count and index. Data are subscribed to in packages, which cost from $1,500 for a small subset of demographic variables to $10,000 for the complete dataset. Subscription prices are for a single-year's data.

Keywords: Computer ownership/Demographics/Internet access/Internet usage/Business usage/Citizenship/E-mail/Health/Legal & insurance/Other/Personal finance/Privacy/Shopping

URL: http://www.commerce.net/research/

Methodology: *Purpose of Data Collection:* To assess the behaviors, usage patterns, and perceptions of the Internet by individuals over the age of 16 in the United States and Canada.

Survey Method: Random digit dial telephone survey with replacement sampling for nonresponse.

Survey Design: The target population is Americans and Canadians aged 16 and over. Respondents are selected from a geographically stratified, unrestricted set of random digit frames of phone exchanges in the United States and Canada. For the June 1998 survey, approximately 175,000 phone numbers were selected. Approximately 5,000 individuals over age 16 answered the survey in June 1998; 8,000 such interviews were conducted in September 1997. Respondent weights are created to adjust for undercoverage and nonresponse. Data are adjusted by age, sex, region, education, race, and Hispanic origin to be statistically representative of the overall population.

Variables Collected: More than 100 questionnaire items elicit data on user demographics (sex, age, income, education, race, ethnicity, occupation) and Internet usage patterns (frequency of use, duration of use, types of use—e-mail, chatrooms, shopping, ftp, telnet).

Statistical Reliability: Confidence intervals/margins of error not readily available.

More detail on survey methodology may be found at http://www.commerce.net/research/gideon/index.html.

Notes: (1) The text of survey questions is available on-line at http://www.commerce.net/research/gideon/quesmenu.htm.

(2) Interactive cross-tabulations are possible on-line.

Contact Info: CommerceNet
4005 Miranda Avenue, Suite 175
Palo Alto, CA 94304
Phone: (650) 858-1930
Fax: (650) 858-1936

CYBER DIALOGUE AMERICAN INTERNET USER SURVEY

Abstract: Cyber Dialogue has been conducting the semiannual American Internet User Survey since 1994. No detailed data on the methodology or the nature of the survey questions is readily available. Cyber Dialogue is a commercial, for-profit market research organization.

Time Period: Survey conducted semiannually since 1994.

Availability: Data are available as a stand-alone survey or as a continuous reporting service. Prices are $1,550 per year for stand-alone reports; $2,600 per year for continuous reporting services.

Keywords: Demographics/Internet access/Internet usage

URL: http://www.cyberdialogue.com/index_4.html

Methodology: *Purpose of Data Collection:* To assess the characteristics and behaviors of U.S. Internet users and potential users.

Survey Method: Random digit dial telephone survey with replacement sampling for nonresponse.

Survey Design: The target population is Americans age 18 and over. The American Internet User Survey has two design elements. The first is a random digit dial telephone survey in which households are screened on their Internet use. The screening survey is used to estimate the adult Internet user population in the United States. For the screening survey, respondents are selected from a geographically stratified set of random digit frames of phone exchanges. For the April 1997 survey, approximately 59,000 phone calls were made; approximately 13,000 households were interviewed regarding Internet use by all individuals in the household.

The second design element is in-depth interviews on Internet use with qualified individuals age 18 and over. One thousand in-depth surveys are conducted with qualified individuals who use the Internet, and 1,000 interviews are conducted with individuals who do not use the Internet. The sample of qualified Internet users is drawn from the screening interviews. To qualify for the in-depth interview, individuals had to be at least 18 years of age and use as least one Internet application other than e-mail. Data are adjusted by age, sex, census region, and level of education to correct for response bias.

Variables Collected: The in-depth interviews cover more than 155 questionnaire items on user demographics (sex, age, education) and Internet usage patterns (frequency of use, duration of use, types of use—e.g., e-mail, chatrooms, shopping, ftp, telnet—etc.).

Statistical Reliability: At the 95 percent confidence level for the 1997 survey, subsets of the total sample reflect the following margins of error: subset sample size of 1,000, ±3.1 percent; subset sample size of 800, ±3.5 percent; subset sample size of 600, ±4.0 percent; subset sample size of 400, ±4.9 percent; subset sample size of 200, ±6.9 percent; and subset sample size of 100, ± 9.8 percent.

For more detail on survey methodology, see Peter Clemente, *State of the Net* (New York: McGraw-Hill, 1998).

Notes: The text of survey questions is not available on-line.

Contact Info: Cyber Dialogue
304 Hudson Street, 6th Floor
New York, NY 10013
Phone: (212) 255-6655
Fax: (212) 255-6622

CYBER DIALOGUE CYBERCITIZEN FINANCE SURVEY

Abstract: Cyber Dialogue initiated the Cybercitizen Finance Survey in 1998. This new survey is intended to track consumer demand for on-line financial services, particularly brokerage/investing, banking, credit card, and insurance services. Cyber Dialogue is a commercial, for-profit market research organization.

Time Period: Survey first fielded in June 1998.

Availability: Data from the Cybercitizen Finance Survey is available in reports, a complete data summary book, and unlimited access to the data by subscribers through an on-line browser. No price information is readily available.

Keywords: Demographics/Internet access/Internet usage/Business usage/Personal finance

URL: http://www.cyberdialogue.com/index_4.html

Methodology: *Purpose of Data Collection:* To track consumer demand for on-line financial services, particularly brokerage investing, banking, credit card, and insurance services.

Survey Method: Random digit dial telephone survey with replacement sampling for nonresponse.

Survey Design: The target population is Americans age 18 and over. Responses include data from 1,000 U.S. adult Internet users and 500 adult nonusers. More than 150 questions focus on consumer financial planning activities both on and off the Internet. Cyber Dialogue reports that "The definition of 'online use' utilized to establish the 1,000 completed user interviews required randomly identified U.S. adults aged 18 years or older to confirm that they use commercial on-line services or one or more Internet applications for business, personal, or academic purposes." No detailed data on response rates is readily available.

Variables Collected: No detailed information is readily available.

Statistical Reliability: No information is readily available.

No other information on the methodology or statistical reliability of this survey is readily available.

Notes: The text of survey questions is not available on-line.

Contact Info: Cyber Dialogue
304 Hudson Street, 6th Floor
New York, NY 10013
Phone: (212) 255-6655
Fax: (212) 255-6622

CYBER DIALOGUE CYBERCITIZEN HEALTH

Abstract: Cybercitizen Health is the newest of Cyber Dialogue's consumer-related Internet survey products. Its purpose is to track consumer behavior, attitudes, and demographics related to use of the Internet for health information. Cyber Dialogue is a commercial, for-profit market research organization.

Time Period: No detailed information readily available.

Keywords: Demographics/Internet usage/Health

URL: http://www.cyberdialogue.com/products/isg/cybercitizen_health.html

Methodology: *Purpose of Data Collection:* To track consumer behavior, attitudes, and demographics related to use of the Internet for health information. Cyber Dialogue's research agenda for this survey is to identify and size current and future markets for on-line health information, products, and services; segment on-line consumers by health-related consumption, attitudes toward health, and on-line usage and intensity; compare the effectiveness of the Internet for consumer marketing with other media; evaluate the profitability of various business models on-line, including those based on advertising, subscriptions, patient referrals, and commerce; provide a model for identifying and acquiring the most valuable on-line consumers; and understand how consumer concerns about privacy, security, and trust affect on-line marketing efforts.

Survey Method: A random sample telephone survey of more than 2,000 U.S. adult Internet users and nonusers, fielded in the second quarter of each year.

Survey Design: No additional information readily available.

Variables Collected: No detailed information readily available.

Statistical Reliability: No information readily available.

No other information on the methodology or statistical reliability of this survey is readily available.

Notes: Cyber Dialogue
304 Hudson Street, 6th Floor
New York, NY 10013
Phone: (212) 255-6655
Fax: (212) 255-6622

CyberAtlas

Abstract: CyberAtlas is an Internet meta-site of on-line facts, statistics, and marketing information related to the Internet. CyberAtlas conducts no original survey research of its own; rather, it provides summaries of, and links to, dozens of studies and surveys on Internet access and usage.

Time Period: Not applicable.

Availability: Not applicable.

Keywords: Demographics/Internet usage/Business usage/Education/Employment & work/Entertainment/ Other/Personal finance/Shopping

URL: http://www.cyberatlas.com

Methodology: Not applicable.

Notes: None.

Contact Info: Not applicable.

GRAPHICS, VISUALIZATION, AND USABILITY (GVU) CENTER, GEORGIA TECH WORLD WIDE WEB (WWW) USER SURVEY

Abstract: The GVU Center has been conducting semiannual Internet use surveys since 1994. The surveys are nonrandom participant surveys completed on the Internet itself. Comparison of GVU WWW User Survey results to Internet user surveys that utilize random techniques reveals that the main area where GVU surveys show a bias exists in the experience, intensity of usage, and skill sets of the users, but not the core demographics of users. Data are freely available on the Web as a public service, although they are not highly detailed with respect to IT and the home. The GVU Center is a research center at the Georgia Institute of Technology.

Time Period: Survey conducted semiannually since 1994.

Availability: Data from each survey are freely available on-line.

Keywords: Demographics/Internet usage/Culture & values/Privacy/Shopping

URL: http://www.cc.gatech.edu/gvu/user_surveys/

Methodology: *Purpose of Data Collection:* To profile Internet users, their characteristics, and why they use the Web so as to improve development of Web-related tools and technologies and to make the Web more usable by all users.

Survey Method: The WWW User Survey is a voluntary, Web-based questionnaire that reflects a nonprobabilistic sample (i.e., survey participants are not randomly selected from a defined population of Internet users).

Survey Design: The target population is all Internet users throughout the world. Participants are solicited through several Web-based means, including announcements on Internet related newsgroups (e.g. comp.infosystems.www.announce, comp.internet.net-happenings, etc.); banners randomly rotated though high-exposure sites (e.g. Yahoo, CNN, Excite, Webcrawler, etc.); banners rotated through advertising networks (e.g. DoubleClick); announcements made to the WWW-surveying mailing list, a list maintained by GVU's WWW User Surveys composed of people interested in the surveys; and, announcements made in the popular media, (e.g., newspapers, trade magazines, etc.). Participants are thus self-selected and voluntarily complete the online survey. The number of participants varies from 1,500 in the first GVU survey in 1994 to more than 5,000 respondents for the tenth survey in 1998.

Variables Collected: Highly detailed demographic data: age; income; race/ethnicity; employment status; occupation; marital status; physical impairment; sex; education; location (country); location (rural, urban, suburban); frequency and duration of Internet use; types of Internet use; attitudes toward the Internet.

Statistical Reliability: Confidence intervals and margins of error do not apply since this is a nonprobabilistic sample.

Data Limitations: The GVU Center reports that "comparisons of the GVU's WWW User Survey results to other published WWW User data that utilize random techniques reveal that the main area where GVU's surveys show a bias exists in the experience, intensity of usage, and

skill sets of the users, but not the core demographics of users. Given the limitations that exist in the data as a result of the methodology, we make the following recommendation to those using the data presented within this report: We recommend that the GVU data be used with the understanding that the data has a bias towards the experienced and more frequent users than random digit dial surveys. We recommend that users interested in understanding the complete spectrum of the Internet and WWW communities augment the GVU data with random sample surveys."

Additional detail on survey methodology is at <http://www.gvu.gatech.edu/user_surveys/survey-1998-10/#methodology>.

Notes: The text of survey questions is available on-line.

Contact Info: GVU Center
College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280
email: www-survey@cc.gatech.edu

INTERNATIONAL DATA CORPORATION (IDC) WORK-AT-HOME SURVEY

Abstract: Survey provides key information on the changing nature of working from home, and focuses on technology acquisition and use, key attitudes, and demographic variables. Major areas of coverage include home businesses, telecommuting, and other forms of corporate home working. IDC is a for-profit commercial marketing organization.

Time Period: Survey conducted annually since 1986.

Availability: Data are available in commercial reports issued through IDC's Home Office Market Program. Reports range in price from $3,000 to $5,000 for a single year of data.

Keywords: Computer ownership/Computer usage/Demographics/Internet access/Internet usage/Business usage/Employment & work

URL: http://www.idc.com/idc7/default.htm

Methodology: Random digit dial telephone survey of 2,000 U.S. households. No other information on survey methodology or on the statistical reliability of the data is readily available.

Notes: The text of survey questions is not available on-line.

Contact Info: IDC Corporate Headquarters
Five Speen Street
Framingham, MA 01701
Phone: 508-872-8200

NUA INTERNET SURVEYS

Abstract: Internet meta-site of on-line facts, statistics, and marketing information related to the Internet. Nua conducts no original survey research of its own; rather, it provides summaries of, and links to, dozens of studies and surveys on Internet access and usage.

Time Period: Not applicable.

Availability: Not applicable.

Keywords: Demographics/Internet usage/Business usage/Employment & work/Entertainment/Other/Personal Finance/Shopping

URL: http://www.nua.ie/surveys/index.cgi

Methodology: Not applicable.

Notes: None.

Contact Info: Not applicable.

THE PEW RESEARCH CENTER FOR THE PEOPLE AND THE PRESS 1998 TECHNOLOGY SURVEY

Abstract: The Pew Research Center for the People and the Press is a nonprofit organization which has been conducting research on technology in the American home since 1994. Large-scale surveys that measure attitudes toward and use of electronic IT have been administered periodically over the past several years. Data are obtained through random digit dial telephone surveys, and tabulations for the most recent (1998) Technology Survey contain historical data for each question. This is a rich source of information on IT and the home, particularly as it relates to the *actual use* of IT.

Time Period: 1994–98

Availability: Data tables are freely available on the Web.

Keywords: Computer ownership/Computer usage/Demographics/Internet access/Internet usage/Citizenship/Culture & values/Education/E-mail/Employment & work/Entertainment/Personal Finance/Privacy/Shopping

URL: http://www.people-press.org/tech98que.htm

Methodology: *Purpose of Data Collection:* To measure attitudes toward and use of electronic IT in the home.

Survey Method: Random digit dial telephone survey with replacement sampling for nonresponse.

Survey Design: The target population is all individuals 18 years or older residing in the continental United States. The sample for this survey is based on a geographically stratified, random digit dial of working banks of telephone numbers in the continental United States. Results for the 1998 Technology Survey are based on telephone interviews conducted with 3,184 adults in the last quarter of 1998. The survey included interviews with a national sample of all adults, and an oversample of 1,184 adults who use the Internet. Results were also drawn from a survey of a nationwide sample of 1,201 adults conducted in December 1998. Respondent weights are created to adjust for nonresponse. Demographic weighting parameters are used to adjust the data to make responses representative of U.S. households with adults 18 years or older. Data on sample size and response rates are not readily available.

Variables Collected: Highly detailed questions/response categories on computer and Internet access, use, and types of use. Limited demographic data are presented; only educational status, employment status, and political party affiliation are shown in the data.

Statistical Reliability: For survey results based on the general public (N = 2,000), the confidence level is 95 percent with error attributable to sampling and other random effects of ±3 percentage points. For results based on Internet users only (N = 1,993) or Internet users who go on-line for news (N = 1,390), sampling error is ±3 percentage points. For results based on Internet users who go on-line for election news (N = 315), sampling error is ±6 percentage points. For results based on subsamples of either the general public or Internet users, sampling error is ±3.5 percentage points. Note that in addition to sampling error, question wording and logistical difficulties in conducting surveys can also introduce error or bias into the findings.

More detail on survey methodology is at http://www.people-press.org/tech98que.htm.

Notes: (1) The text of survey questions is available on-line at http://www.people-press.org/tech98que.htm.

(2) The Pew Research Center has five key research themes, one of which is Technology in the American Home, which focuses on IT. Related survey questions appear in many of the dozens of surveys the center conducts, so it is difficult to isolate a single survey series that contains appropriate data. The data tables for the 1998 Technology Survey contain data for all previous times that an individual question may have been asked, so to this extent the reported findings contain comparable historical data.

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U.S. Bureau of the Census Current Population Survey (CPS)

Abstract: The Current Population Survey is conducted monthly by the U.S. Bureau of the Census. Every few years, questions related to computer ownership, computer usage, Internet access, and Internet usage are included in the monthly survey. These data are among the few resources that clearly distinguish home use of computers and the Internet from other locations of use.

Time Period: October 1984; October 1989; October 1993; November 1994; October 1997; December 1998.

Availability: Reports and tabulations for October 1984, 1989, 1993, and 1997 are available at http://www.census.gov/population/www/socdemo/computer.html. Tabulations for November 1994, October 1997, and December 1998 are available at www.bls.census.gov/cps/computer/computer.htm.

Keywords: Computer ownership/Computer usage/Demographics/Internet access/Internet usage/Business usage/Education/E-mail/Employment & work/Entertainment/Other/Personal finance/Shopping

URLs: http:/www.census.gov/population/www/socdemo/computer.html
http://www.bls.census.gov/cps/computer/computer.htm

Methodology: *Purpose of Data Collection:* To collect detailed data on labor force characteristics of the U.S. population. The monthly CPS is occasionally supplemented with specialized questions related to topics of national interest such as health care, school enrollment, and computer usage.

Survey Method and Design: Data are based on interviews with a randomly selected sample of 50,000 U.S. housing units, with about a 94-percent response rate. The present CPS sample covers all 50 states and the District of Columbia.

Variables Collected: There are several special supplements to the CPS that are IT-related: these were conducted as part of the CPS in October 1993, November 1994, and October 1997. Additional data are available for the years 1984 and 1989; these earlier data are reported in the tabulations for the October 1993 supplement. The November 1994 supplement contains, in addition to the highly detailed demographic data, data on types of computer use in the home. The 1997, 1998, and 2000 supplements include questions related to home computer and Internet access and use.

Statistical Reliability: Standard errors and confidence intervals are reported at 90 percent confidence levels and .10 levels of significance. Detailed parameter estimates for the 1994-1998 supplements may be found at www.bls.census.gov/cps/computer/computer.htm.

More detailed information on the CPS methodology in general and the computer surveys since 1994 in particular may be found at http://www.bls.census.gov/cps/mdocmain.htm.

Notes: (1) October 1993 data tabulations (including 1989 and 1984 historical comparisons) are available at http://www.census.gov/population/www/socdemo/computer.html.

(2) The 1994 Computer Uses data and the 1997 Internet Usage data are located at http://www.bls.census.gov/cps/computer/computer.htm.

(3) Interactive cross-tabulations are not possible on-line.

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Appendix B. Annotated Bibliography of Major Works

Written works used to construct the bibliographic database related to the impacts of IT in the home were collected in four ways:

- **Keyword search.** A number of databases were searched using a series of keywords to identify works related to IT in the home. The search process was iterative and was repeated with varying keywords until most results were works appropriate to the topic. The author names that appeared most frequently were then subjected to further searches for additional relevant works. The resulting works were then subjected to a series of computer searches and analyst review to verify relevance. Works of borderline significance were retained.

- **Networking.** Known experts in the field were queried by e-mail and asked to suggest works they considered particularly important to the topic.

- **Ad hoc discovery.** Relevant works were discovered during Web searches, from reviews of bibliographies of other works, and from voluntary submissions.

- **Bibliography research.** Nearly 50 bibliographies contained in relevant works were examined. Those bibliographies either confirmed relevant works already on the list or identified additional works to include.

Criteria for Annotation

There were two criteria for inclusion as a major work. The primary criterion was the level (or unit) of analysis of the study. Works to be annotated had to focus on family-, home-, or household-level effects of IT; studies focusing on individual effects were also included if the context of the research was generally home computing or personal Internet use. Excluded is research that relates to the impacts of home IT activities on business or society. For example, the substantial literature on the impacts of telecommuting on business productivity, job satisfaction, employee turnover, and so forth was not included. The philosophical literature on the impact of home IT activities on culture, psychological perceptions of time and space, democratic participation, social cohesion or anomie, etc., was similarly excluded.

The second criterion for annotation was that they had to be either published or available on the Web from a credible source. Only 30 works were identified that met these two key criteria. Each annotation describes: (1) the purpose of the work, (2) the methodology and source of data (if it is an empirical study), and (3) key findings or features of the work.

Methodology

The annotated works included in the database were identified primarily by database searches and an expert networking process conducted by SRI International. These searches located approximately 180 works related to the implications of IT for the home; these resources were overwhelmingly published articles, books, and conference proceedings. A few self-published Web reports were also identified. There are known limitations to this type of literature search methodology; for example, book chapters in edited volumes are not always indexed, and there are time lags in the indexing processing (works published in one year may not be listed for 12 months). Thus, the original set of 180 works reflects indexing as of December 1998.

The original list was reduced to roughly 100 based on a close reading of their titles and abstracts for relevance to the project. These 100 works were then read carefully and included or excluded depending on whether they met the criteria identified above. In addition, the bibliographies and reference lists of literature deemed relevant to the scope of work were scanned to identify other potentially relevant publications. Several works to be annotated were subsequently identified in this way.

A second source of relevant literature was the *Bibliography of Information Technology: An Annotated Critical Bibliography of English Language Sources Since 1980* (Whitaker et al. 1989, chapter 8, "Household & Community References"). Finally, a few works

were "opportunistic" discoveries: for example, other chapters found in edited volumes or other papers found in conference proceedings.

KEYWORDS

The annotated works also contain highly simplified keyword designations. These keywords reflect basic differentiations in the subjects of the works and are not based on Library of Congress subject heading classifications. A list of keywords used and a brief description of their meaning are presented in table B-1.

Table B-1. Annotated works on the implications of IT in the home: keyword glossary

Keyword	Description
Adoption	Analysis or data related to factors that determine IT adoption in households
Citizenship	In-depth analysis or data related to uses of IT for citizenship activities
Computer access	Analysis or data related to the availability of a computer in the home
Computer usage	Analysis or data related to how the computer is actually used (e.g., for games, education, word processing, etc.)
Demographics	Analysis or data related to demographic characteristics of households and individuals with (or without) access to computers and the Internet (e.g., age, sex, ethnicity, income, education level, geographic region of users)
Education	In-depth analysis or data specifically related to uses of IT in the home for educational purposes
Empirical	Designates works that are actual studies of home IT and that use data derived from research or national surveys
Employment & work	In-depth analysis or data specifically related to uses of IT in the home for employment and work purposes
Equity	Designates works that focus on equitable access to home IT or the informationally disadvantaged
Family impacts	Designates works that specifically address the impacts of IT on the family
Framework	Designates works that are theoretical or heuristic in nature and intended to provide an analytical framework for studying the impacts of IT in the home
Health	In-depth analysis or data specifically related to uses of IT in the home for health and medical purposes
HomeNet	Designates works that use data from the HomeNet study of residential Internet use based at Carnegie Mellon University
Internet access	Analysis and data related to home access to the Internet
Internet usage	Analysis and data related to how the Internet is used (e.g., who uses the Internet, how frequently, for how long, for what purposes, etc.)
Psychological impacts	Analysis or data related to the psychological impacts of home computing and Internet use (e.g., social withdrawal, friendship creation, community involvement, Internet addiction, etc.)
Time allocation	Analysis or data related to how households allocate time to various activities (watching television, computing, sports and recreation, sleeping, etc.)

Annotated Bibliography of Major Works Related to the Implications of IT for the Home

Margaret Bruce, "Home Interactive Telematics: New Technology With a History," *Concerning Home Telematics: Proceedings of the IFIP TC 9 Conference on Social Implications of Home Interactive Telematics*, Felix Van Rijn and Robin Williams, eds. (Amsterdam: Elsevier Science Publishers, 1988), pp. 83–93.

Bruce summarizes the experience of commercial interactive videotext services in Britain (Prestel), France (Teletel), Australia (Viatel), and Germany (Bildschirmtext). These services were, in some ways, a precursor to Internet-type services, and were commercially introduced in the early 1980s. Household adoption rates were far lower than expected, however, and by the late 1980s interactive videotext services were only marginally important information technologies.

Key findings include: (1) In all four countries, very few women used interactive videotext services (less than 10 percent of users were female). (2) Innovators failed to account for cost, affordability, sex, race, and class as important determinants of household IT adoption rates. (3) Interactive videotext subscribers tended to use the service for such activities as games, participation in "lonely hearts clubs," shopping, travel and weather information, news, home banking, and entertainment.

Andre H. Caron, Luc Giroux, and Sylvie Douzou, "Uses and Impacts of Home Computers in Canada: A Process of Reappropriation," *Media Use in the Information Age: Emerging Patterns of Adoption and Consumer Use*, Jerry Salvaggio et al., eds. (Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., 1989), pp. 147–62.

The authors evaluate the dynamics of home computer adoption and use by those who were not computer specialists. They conducted a three-stage analysis of French-Canadian viewers of an educational television program aired in Quebec to inform the general public about home computing. The authors sent a questionnaire to 4,300 viewers of the program in November 1983 (response rate 50 percent), then sent a follow-up questionnaire to a subset of these viewers in November 1985 (response rate almost 50 percent). These second questionnaires were then followed up with 18 in-depth family interviews. The results of these questionnaires and interviews are presented in the chapter.

Households that were recent adopters of home computers in 1983 had three distinctive patterns of usage by 1985: households that had quit using the computer entirely, those that had continued to use it, and those that not only continued to use it but bought a second home computer. Socioeconomic factors were *not* important predictors of these patterns of use. What seemed to differentiate the groups is the degree to which the motivation for the original computer purchase was to assist with work-related tasks and not simply for entertainment purposes or to learn about computer technology. Additionally, in households where there was a second home computer, spouses and children used it at higher levels than in households with only one computer. Due to the study's research design and purpose, findings are more usable for theory building than for generalizations or conclusions about adoption behaviors in computing households.

Thomas Childers, *The Information-Poor in America* (Metuchen, NJ: The Scarecrow Press, 1975).

This text is a pioneering literature review and bibliography on the information needs of disadvantaged groups in American society. While the scope and implications of the review are not focused on home computers or the Internet (since the publication of this work precedes both of these technologies), it is invaluable for its summary of the empirical evidence on *how* different social groups are informationally dis-

advantaged. It also identifies the need to conduct research on how people actually use and retain information in their problem solving and how this affects individual quality of life. Childers differentiates between more than a dozen areas of information needs (e.g., health, the law, employment, and transportation) and identifies nine groups of informationally disadvantaged citizens in American society.

Peter C. Clemente, *State of the Net: The New Frontier* (New York: McGraw-Hill, 1998).

Clemente provides an extensive summary and presentation of data obtained from the semiannual American Internet User Survey conducted by Cyber Dialogue on consumer Internet access and usage. This survey is one of the few nationally generalizable marketing studies done on patterns of American Internet use. The text covers data for the years 1994–97. (The American Internet User Survey is a random digit dial telephone survey with replacement sampling for nonresponse. The target population is Americans age 18 and over. The American Internet User Survey has two design elements. The first is a random digit dial telephone survey in which households are screened on their Internet use. The screening survey is used to estimate the adult Internet user population in the United States. For the screening survey, respondents are selected from a geographically stratified set of random digit frames of phone exchanges. For the April 1997 survey, approximately 59,000 phone calls were made; approximately 13,000 households were interviewed regarding Internet use by all individuals in the household.)

Key findings include the following: (1) Women have notably lower rates of Internet use than men. (2) Nearly one-third of the Internet user population in 1997 was "Gen Xers," individuals between the ages of 18 and 29. (3) Nine out of 10 people use the Internet for personal reasons, and the World Wide Web is the single most popular Internet application, exceeding even e-mail. (4) The four most popular areas of personal Internet use are (in order): news, hobbies, travel, and entertainment. (5) Internet user households are affluent; just under two-thirds of such households have incomes greater than the national average of roughly $45,000 per year.

Mary Dee Dickerson and James W. Gentry, "Characteristics of Adopters and Non-Adopters of Home Computers," *Journal of Consumer Research* 10:225–35.

Dickerson and Gentry profile the type of individual most likely to adopt a home computer. They depart from traditional sociodemographic research on this question by exploring the relationship between the creativity of the consumer and his/her experience with other technical products and PC adoption. The data and analysis are based on a 1981 survey of computer club members and subscribers to *Psychology Today* magazine. The authors sent out just over 2,000 surveys; they received 639 usable questionnaires. Their adopter profiles are largely similar to that known for early adopters of household technologies: adopters were largely middle aged, had high incomes, and were well-educated. The psychographic profiles indicate that PC adopters are also "logical introverts," and that adopters are significantly different than nonadopters in terms of their experience with a wide variety of technical household products.

William H. Dutton, Everett M. Rogers, and Suk-Ho Jun, "The Diffusion and Impacts of Information Technology in Households," *Oxford Surveys in Information Technology, Vol. 4*, P. I. Zorkoczy, ed. (UK: Oxford University Press, 1987), pp. 133–93.

This major literature review of existing research on home computing and cable television in households examines: (1) factors related to the adoption of IT, (2) how IT is used in households, and (3) the social implications that extend from these patterns of adoption and use. The meta-research presented here integrates survey research primarily from the United Kingdom and United States. The work provides a helpful conceptual framework for understanding the social impacts of IT in the home and a comprehensive review of works published through 1987.

Oliver Egger and Matthias Rauterberg, "Internet Behaviour and Addiction," http://www.ifap.bepr.ethz.ch/~egger/ibq/res.htm.

This student research thesis on whether heavy use of the Internet reflects addictive behavior uses data from an on-line availability survey posted on the World Wide Web. Egger and his thesis advisor, Rauterberg) are affiliated with the Swiss Federal Institute of Technology in Zurich. The questionnaire was posted on the Web in German and English, and electronic announcements about the survey were posted via e-mail, newsgroups, and websites to solicit respondents. The survey was posted for six weeks. A total of 454 valid surveys were obtained; 61 percent of the respondents were from Switzerland, 22 percent were from the United States, and the remainder were from a variety of other countries. The survey contained nearly 50 individual items in five major categories: social uses of the Internet; usage patterns; feelings; experiences; and basic demographics. This study is notable for its relevance, appropriateness of questionnaire items to Internet addiction literature and issues, and thoroughness and clarity of method. Statistical analysis of each questionnaire item is presented.

Because this is a nonprobabilistic study, its findings cannot be generalized to a larger population. However, the findings strongly suggest future research and theory on the relationship between Internet use and addictive behaviors. Key findings include the following: (1) Ten percent of respondents perceived themselves as addicted to, or dependent on, the Internet; and objective measures of addiction were, on the whole, statistically significant for this group. (2) There were no statistically significant demographic differences among people who considered themselves Internet addicts in terms of sex, age, nationality, or living situation.

Joseph B. Giacquinta, JoAnne Bauer, and Jane E. Levin, *Beyond Technology's Promise: An Examination of Children's Educational Computing at Home* (Cambridge, UK: Cambridge University Press, 1993).

This book reports the results of a qualitative study (Studies of Interactive Technology in Education—SITE) of 70 families from 1984–86. The purpose was to analyze how children used computers at home; the focus was not on learning outcomes for children. The families in the SITE study were primarily white, middle and upper class households from the New York City tri-state area. Each family was studied for four months; fieldworkers made 6 to 10 visits of 1 to 3 hours per visit and recorded data in a field log. Log content was analyzed for patterns of computer use.

Key findings include the following: (1) A "near absence" of children's academic computing at home; that is, computing for the purpose of learning school subjects and critical thinking. Game playing consumed most of the children's time on the computer. (2) Children (or families) were discouraged from using or talking about their computers because of negative social pressures at school and by neighbors. (3) Parental support and encouragement was an important factor in children's use of the computer for educational purposes. (4) A substantial number of differences by sex emerged in patterns of use of the computer, attitudes toward computing, and roles in computing decisions.

Penny Gurstein, "Working at Home and Living at Home: Emerging Scenarios," *Journal of Architectural and Planning Research* 8(2):164–80.

Gurstein assesses the impact of home-based computer work on home and work life. The findings and analysis are based primarily on a survey conducted in 1989 of 45 homeworkers and 9 office workers in California who used telecommunications and IT to conduct their work. (No information is available on the sample frame or research methodology.) Although the findings from this research cannot be generalized to a larger population, the author does detect household-level impacts of home-based computer work that are suggestive for further research. First, she finds that there is an important blurring of work and home boundaries—the physical space itself combines work and home characteristics (e.g., a home office in the

living room); homeworkers have a more difficult time separating work and home activities (e.g., they can never get away from their work); and the home loses its role as a refuge from the outside world (e.g., clients visit the home office). Second, as a consequence, homeworkers report chronic conflicts between home and work activities, difficulty in delineating the public and private spaces of the home, role conflicts, the blurring of work and leisure time (with the net result of less leisure time), the tendency to "overwork" relative to office peers, and a sense of isolation from and invisibility to office-based colleagues. The research is valuable for highlighting the potential of homeworking in fundamentally affecting roles of family members and the role of the home itself relative to family members.

Laurence Habib and Tony Cornford, "The Virtual Office and Family Life," *SIGCPR/SIGMIS '96: Proceedings of the 1996 Annual Meetings of the Association for Computing Machinery Special Interest Group on Computer Personnel Research/Special Interest Group on Management Information Systems* (Denver: Association for Computing Machinery, 1996), pp. 296–304.

Habib and Cornford argue that the impact of telework (telecommuting) arrangements on the family has been a neglected area of study. Traditional research on the impacts of telework focuses on productivity, job satisfaction, job stress, overwork, career paths, and so on. Because telework shifts the locus of work from office to home, the boundary between office and home is blurred; this has consequences for family dynamics. The authors offer a framework for studying the impact of telework on families; four core dimensions (family roles, the physical space and environment of the home, time allocation patterns, and household finances) are analyzed in the context of changing home rules and norms caused by telework.

James C. Hersey, Jennifer Matheson, and Kathleen N. Lohr, *Consumer Health Informatics and Patient Decision-Making*, AHCPR Report No. 98-N001 (Rockville, MD: U.S. Department of Health and Human Services, Agency for Health Care Policy and Research, 1997).

This analysis is an important review of the literature on the effectiveness and impacts of health informatics tools on consumer health. Such tools are designed to give patients information and help their decision-making on treatment choices for disease, illness, or healthcare. Health informatics cover a wide range of media and technologies including brochures, videotapes, interactive video, audiotapes, computer-generated letters, and Internet and other network-based information systems. The authors review and critique research designs for studying the impact of health informatics tools on consumers and make several substantial recommendations. In addition, they note that "a major knowledge gap" exists on the effectiveness of different informatics tools relative to one another (e.g., videotapes versus brochures, etc.). Few studies have been conducted on interactive, network- and computer-based informatics tools, but those that have find statistically significant impacts on such factors as patient knowledgeability, hospitalization rates, satisfaction with medical care, and overall health.

Wolfgang Hesse, Sigrun Goll, Thomas Biedassek, and Julie Remmington, "Quality of Life Criteria for Assessing Information Technology in the Home Environment," *Human Aspects in Computing: Design and Use of Interactive Systems and Information Management. Proceedings of the Fourth International Conference on Human-Computer Interaction, Vol. 2* (Amsterdam: Elsevier Science Publishers, 1991), pp. 1270–75.

This chapter presents an analytical framework that developers of new information technologies can use to assess the impacts of their technologies on the quality of life of the home environment. Although short, the piece is useful because it is the only work that explicitly provides a quality of life approach to understanding the impacts of home-based IT. The authors offer and explain quality of life criteria related to physical, cognitive, emotional, professional, social, and "self-reflection" impacts.

Kevin A. Hill and John E. Hughes, *Cyberpolitics: Citizen Activism in the Age of the Internet* (Lanham, MD: Rowman & Littlefield Publishers, 1998).

Hill and Hughes explore and evaluate several hypotheses about political ideology, the content of political speech on the Internet, and participation in on-line political activism by traditionally disenfranchised groups. Of relevance here is chapter 2, "Internet Activists." The authors use 1995 and 1996 data from the Pew Research Center for the People and the Press to compare Internet activists to both the general public and the general Internet user population. (The Pew surveys are random digit dial telephone surveys with replacement sampling for nonresponse whose target population is all individuals 18 years or older residing in the continental United States.) Internet activists are identified as those individuals who chat about politics and post political messages on-line.

Key findings include the following: (1) Internet activists are predominantly (77 percent) male. (2) The proportion of Internet activists that are nonwhite is comparable to that of the U.S. population—there does not appear to be an "ethnic gap" in Internet activism. (3) Internet activists are much more affluent and better educated than the general U.S. population. (4) Multivariate analysis indicates that Internet activists are more liberal than the general public on issues such as banning books, accepting homosexuality, and opposing the regulation of sexually explicit materials on the Internet (the differences between Internet activists and the general public were statistically significant at the .001 level). (5) Multivariate analysis indicates that Internet activists are also more politically active and knowledgeable than the overall population. (They voted more, read the paper for news more, and listened to news radio more; these differences were statistically significant at the .001 level.)

Starr R. Hiltz and Murray Turoff, *The Network Nation: Human Communication Via Computer, rev. ed.* (Cambridge, MA: The MIT Press, 1993).

This book is an extensive treatment of computer-mediated human communication, particularly through computer conferencing. Of relevance here is chapter 5, "Computer-Mediated Communications and the Disadvantaged," which details the many ways that computer-mediated communication systems can enhance the well-being of the socially disadvantaged, who include the poor and those who are mobility-limited (the elderly, prisoners, people who are physically or mentally handicapped, and people in isolated rural communities).

Donna L. Hoffman, William D. Kalsbeek, and Thomas P. Novak, "Internet and Web Use in the U.S.," *Communications of the ACM* 39(12):36–46.

This article evaluates estimates of the size of the U.S. Internet population generated by four different national surveys: the CommerceNet/Nielsen Internet Demographic Survey, the Cyber Dialogue American Internet User Survey, the Pew Research Center for the People & the Press' Technology in the American Household Survey, and an O'Reilly & Associates market research survey. In addition, the authors provide more precise 1995 estimates of this population based upon their revisions to the CommerceNet/Nielsen Internet Demographic Survey. The article aims to provide more reliable baseline data on the Internet population to consumers, market researchers, investors, and policymakers, among others.

The authors find that the major reason these surveys differ in their estimates on the size of the U.S. Internet population is because of their definition of "Internet use." The value of this article to the present topic is not so much its revised estimates of the Internet user population (which cannot be restricted to users of home-based IT), but its detailed discussion of how to weight and analyze the results of national random digit dial telephone surveys and the sources of bias in these surveys.

James E. Katz and Phillip Aspden, "A Nation of Strangers?," *Communications of the ACM* 40(12):81–86.

Katz and Aspden present the results of a national random telephone survey of 2,500 households in October 1995 that was augmented by another national random telephone sample of 400 Internet users. (No other information is available on the survey methods or designs.) The authors attempt to determine how the Internet affected community involvement and to explore prevailing theories that Internet users become isolated and disconnected from their communities; in addition, they address how the Internet was used to make and form friendships. Respondents were divided into five categories: Internet users (8 percent); former Internet users (5 percent), those aware of the Internet but nonusers (68 percent); and those not aware of the Internet (16 percent).

Overall, the authors found that after controlling for demographic differences between groups (age, sex, education, race, and income), there were no statistically significant differences in the degree to which respondents were members of religious, leisure, or community organizations. In addition, the vast majority of Internet users (both recent and long term) reported no change in the amount of time spent with family and friends on the phone or through face-to-face contact. Regarding friendship creation, 14 percent of the Internet users reported that they "knew people only through the Internet whom they considered their friends," and 60 percent of this group reported that they eventually met their Internet friends face-to-face. Because of the lack of information about the sample frames and methods used for the study, generalizations to larger populations cannot be made. The findings are, however, suggestive for theory and future research.

Robert Kraut, Vicki Lundmark, Michael Patterson, Sara Kiesler, Tridas Mukopadhyay, and William Scherlis, "Internet Paradox: A Social Technology That Reduces Social Involvement and Psychological Well-Being?," *American Psychologist* 53(9):1017–31.

This article reports findings from the HomeNet field trial of residential Internet use, a study based at Carnegie Mellon University. The authors analyze longitudinal data from this study using path-analytic models to determine the relationship between extensive Internet use and social involvement (measured as family communication, size of social networks, and social support) and psychological well-being (measured as loneliness, stress, and depression). In the HomeNet study, families were given home computers and access to the Internet; their usage patterns were then monitored through both passive and active mechanisms (e.g., computer-tracked site visits, questionnaires, and home interviews). The research findings here are based on an availability sample of 169–231 individuals in the Pittsburgh area. Households in the study were recruited from four local high schools and four community development centers; students who worked on the school newspaper and their families were the target population for the high schools, while members of the board of directors were recruited from the community centers. Because this is a nonprobabilistic sample, the research findings cannot be generalized to a larger population, although the findings are suggestive for theory and future research.

In general, the authors found that greater use of the Internet is associated with: (1) "small but statistically significant declines in social involvement" as reflected by family communication and the size of the individual's social network, (2) self-reported loneliness, and (3) increased depression. These correlations held even after controlling for initial states of loneliness, social involvement, Internet use, depression, stress, etc. Although the authors argue that their methods and findings indicate a *causal* relationship between increased Internet usage, declining social involvement, and worsening psychological states, this is an overstatement. The models do not account for intervening factors known to trigger social withdrawal and depression, do not address the possibility that "Internet addiction" could account for the relationships they detect, or allow for the possibility that greater Internet use could be epiphenomenal to social withdrawal or other psychological states.

Robert Kraut, Tridas Mukhopadhyay, Janusz Szczypula, Sara Kiesler, and William Scherlis, "Communication and Information: Alternative Uses of the Internet in Households," *CHI '98; Proceedings of the 1998 Conference on Human Factors in Computing Systems, Association for Computing Machinery Special Interest Group on Computer-Human Interaction* (Los Angeles: Association for Computing Machinery, 1998), pp. 368–75.

This work assesses which is more important to Internet users: interpersonal communication or information acquisition and entertainment? The authors base their analysis on the HomeNet field trial of residential Internet use, a study based at Carnegie Mellon University. In the HomeNet study, families were given home computers and access to the Internet; their usage patterns were then monitored through both passive and active mechanisms (e.g., computer-tracked site visits, questionnaires, and home interviews). The research findings here are based on an availability sample of 110 households (229 individuals) in the Pittsburgh area. Households in the study were recruited from four local high schools and four community development centers; students who worked on the school newspaper and their families were the target population for the high schools, while members of the board of directors were recruited from the community centers. Because this is a nonprobabilistic sample, the research findings cannot be generalized to a larger population, although the findings are suggestive for theory and future research.

Key findings include the following: (1) Internet users strongly preferred interpersonal communication over information acquisition and entertainment in terms of their patterns of Internet and Web use. (2) E-mail was no more popular for some groups than others, particularly those classified as more "sociable"; however, women were heavier e-mail users than men and lighter users of the Web. (3) Internet use patterns among study participants could not be differentiated by income or education.

Robert Kraut, William Scherlis, Tridas Mukhopadhyay, Jane Manning, and Sara Kiesler, "The HomeNet Field Trial of Residential Internet Services," *Communications of the ACM* 39(12):55–63.

This article presents the results of a 1-year snapshot (1995–96) of Internet usage by families in the Carnegie Mellon HomeNet study. In this study, families were given home computers and access to the Internet; their usage patterns were then monitored through both passive and active mechanisms (e.g., computer-tracked site visits, questionnaires, and home interviews). The research findings are based on an availability sample of 48 families in the Pittsburgh area. Because this is a nonprobabilistic sample, the research findings cannot be generalized to a larger population, although the findings are suggestive for theory and future research.

Key findings include the following: (1) People using the Internet search for and access sites that are unique to their individual interests and needs. (2) Use of e-mail drove Internet use for HomeNet participants, largely because teenage family members were the heaviest Internet users and they tended to use e-mail more than any other Internet service. (3) Household income and education did not differentiate patterns of Internet use, but race, sex, and age did. (4) Psychological dispositions, such as innovativeness, depression, and social extroversion did not differentiate patterns of Internet use once demographic factors were controlled for. (5) Males (particularly teenagers) and whites are the heaviest users of the Internet.

Edward F. McQuarrie, "The Impact of a Discontinuous Innovation: Outcomes Experienced by Owners of Home Computers," *Computers in Human Behavior* 5:227–40.

McQuarrie explores computer usage behaviors in terms of the degree of computer usage, satisfaction with computing technology, and attitudes toward computing technology. His purpose is to see if product strength, adopter resources, instrumentality, and social integration act as effective determinants of adoption behaviors. The data and analysis are based on a survey implemented in 1984. The sample frame

was based on several thousand computer owners who had returned a coupon to a market research firm. Two samples of 350 Apple and Radio Shack computer owners were studied for the pilot survey; two samples of 700 Apple, Radio Shack, Commodore, and Texas Instruments owners were used for the main study. The response rates for the pilot study and main study were 52 and 45 percent, respectively. McQuarrie's main findings related to the influence of technical factors in usage patterns. In general, the degree of PC use is mainly associated with high-quality equipment. Social integration also proved to be an important determinant of usage patterns.

National Telecommunications and Information Administration (NTIA), "Falling Through The Net: A Survey of the 'Have Nots' in Rural and Urban America," http://www.ntia.doc.gov/ntiahome/fallingthru.html.

This report presents key findings on the degree to which computers and Internet access are becoming a universal service in the United States. Findings are benchmarked to the diffusion of telephones in U.S. households. This is the first of NTIA's reports on national access to home computers and the Internet. The findings are based on the November 1994 Current Population Survey (CPS) conducted by the Bureau of the Census. CPS data are based on interviews with a randomly selected sample of 50,000 U.S. housing units; the response rate is about 94 percent. The present CPS sample covers all 50 states and the District of Columbia.

Key findings of this report include the following: (1) The rural poor have the lowest rates of home computer and modem penetration rates. (2) Minority groups tend to have the lowest levels of computer and modem access but use on-line services for job searches and taking courses more than whites. (3) It is not clear whether income or demographic factors (sex, race, education, age) are the primary determinants of the observed geographic differentiation of household access to computers and modems.

National Telecommunications and Information Administration (NTIA), "Falling Through the Net II: New Data on the Digital Divide," http://www.ntia.doc.gov/ntiahome/net2/falling.html.

This is the second of NTIA's reports on national access to home computers and the Internet. The findings are based on the October 1997 Current Population Survey (CPS) conducted by the Bureau of the Census. CPS data are based on interviews with a randomly selected sample of 50,000 U.S. housing units; the response rate is about 94 percent. The present CPS sample covers all 50 states and the District of Columbia.

Key findings of this report include the following: (1) In 1997, 37 percent of U.S. households had personal computers, and 19 percent had home-based access to the Internet. (2) The "digital divide" between some groups of Americans has continued to increase. There is a greater gap in computer ownership between upper and lower income levels, and African Americans and Hispanics lag farther behind whites than in 1994. (3) After accounting for income, there are no significant differences in computer ownership for rural, urban, and central city areas (although rural areas still have substantially lower levels of on-line access). (4) Groups that are least Internet connected are the rural poor, rural and central [inner?] city minorities, households whose head is under age 25, and female-headed households.

National Telecommunications and Information Administration (NTIA), "Falling Through the Net: Defining the Digital Divide," http://www.ntia.doc.gov/ntiahome/digitaldivide/.

This is the third of NTIA's reports on national access to telephones, home computers, and the Internet. The findings are based on the December 1998 Current Population Survey (CPS) conducted by the Bureau of the Census. CPS data are based on interviews with a randomly selected sample of 50,000 U.S. housing units; the response rate is about 94 percent. The present CPS sample covers all 50 states and the District of Columbia.

The key finding of this report is that, in spite of rapidly growing rates of home computer and Internet access among all Americans, the digital divide continues to widen. The NTIA reports that "The gaps between white and Hispanic households, and between white and black households, are now more than 6-percentage points larger than they were in 1994. Between 1997 and 1998, the divide between those at the highest and lowest education levels increased 25 percent, and the divide between those at the highest and lowest income levels grew 29 percent."

Thomas Novak and Donna Hoffman, "Bridging the Digital Divide: The Impact of Race on Computer Access and Internet Use," http://www2000.ogsm.vanderbilt.edu/papers/race/science.html.

This working paper is a longer version of the article "Bridging the Racial Divide on the Internet" published in *Science* (April 17, 1998). The authors analyze the differences between whites and African Americans in terms of their computer access, Internet access, and use of the World Wide Web. In particular, they wish to determine whether apparent racial differences in access and use can be accounted for by income and educational factors. The findings are based on an analysis of data obtained in December 1996–January 1997 through the CommerceNet/Nielsen Internet Demographic Survey. This survey is conducted semiannually through a random digit dial sampling frame of individuals age 16 and over in the United States and Canada. Novak and Hoffman use data only for the 5,813 U.S. respondents; the data are weighted to be statistically representative of the total U.S. population age 16 and over.

Excluding student (high school and college) computer use and behavior, the authors found: (1) After controlling for income, there are no statistically significant differences between whites and African Americans in terms of their ownership of home computers. (2) Regardless of race, educational variables explain access to computers at work. (3) Although income explains racial differences in ownership of home computers, whites are still more likely to own a home computer at all educational levels. With respect to students, there are pronounced racial differences in access to home computers that cannot be accounted for by household income levels.

Organisation for Economic Co-operation and Development (OECD), *Information Technology Outlook 1997* (Paris, 1998).

This text presents a comprehensive overview of the status of IT technology and IT networks in OECD member countries and addresses public policies for the promotion of IT. Of relevance here is chapter 5, "Access to and Use of Information Technologies at Home," which focuses on the degree of penetration of IT technologies and Internet access in the home in the industrialized nations. Data are from surveys based in the individual member countries.

Key findings of this chapter include the following: (1) Income is the factor that best explains household penetration rates (with an R-square of .77). (2) Family type, particularly the age of the head of the household, is an important predictor of penetration rates due to the presence or absence of children and teens in the household. (3) Penetration rates are much higher in urban areas. (4) The most frequent uses of home computers are (in order) games, educational activities, word processing, recordkeeping, and work-related activities. (5) The presence of a home-based business is an important factor in a household's decision to purchase a home computer.

John A. Riccobono, *Use of Electronic Information Technologies for Non-School Learning in American Households: Report of Findings From the 1985 Home Information Technology Study (HITS)*, CS-86-215 (Washington, DC: U.S. Department of Education, Center for Statistics, 1986).

This is one of two major reports on the results of the Home Information Technology Study which was designed to provide a national picture of out-of-school (informal) learning activities by Americans and the types of learning resources they used. This report focuses on the availability of IT in the home and IT use for educational purposes. IT is broadly defined and includes print, audio, video, and computer technologies. The target populations were children 2–5 years old, children 6–11 years, children 12–17 years, and adults 18 years and older. HITS was a national random digit dial telephone survey conducted from February through June 1985. A total of 38,566 unique phone numbers were called; 16,591 of these were identified as households and 90 percent were rostered for use in the study. Of those households rostered, approximately 30 percent were sampled for interviews, and response rates varied from 76 to 96 percent for the four target populations. Roughly 4,700 interviews were conducted in all; Margins of error range from +/- 2 percent to +/- 4 percent for the four target populations. Riccobono cautions that inferences to the elderly and low-income populations should be made with caution because of selection bias in random digit dial telephone methods. Otherwise, data were adjusted and weighted to be statistically representative of the U.S. population.

Key findings include the following: (1) In 1985, 13 percent of adults in U.S. households, and approximately 20 percent of children aged 6–17, had access to a computer at home. (2) Income was strongly associated with computer ownership. (3) When computers were available, they were more likely to be used for learning by children than by adults. (4) Computers were almost three times more likely to be used for intellectual rather than recreational learning. (5) There were pronounced differences by sex in every age group, with men being far more likely to use the computer than women. (6) Computer games and programs were perceived as "not helpful" to learning activities by just over half of every age group.

Francine Riley and Donna W. McCloskey, "GTE's Experience With Telecommuting: Helping People Balance Work and Family," *SIGCPR/SIGMIS '96; Proceedings of the 1996 Annual Meetings of the Association for Computing Machinery Special Interest Group on Computer Personnel Research/Special Interest Group on Management Information Systems* (Denver: Association for Computing Machinery), pp. 85–93.

Riley and McCloskey report the results of a 6-month telecommuting pilot study implemented by GTE Corporation in Dallas in 1993. GTE's goal was to experiment with telecommuting options to improve employee work performance. The company allowed participants in the pilot study to work at home 1 day per week; 120 employees participated, and almost all were management-level workers. The pilot program was evaluated at its 3-month midpoint and at the conclusion of the study through detailed questionnaires administered to the participants, their supervisors, and their customers. Although the bulk of the findings relate to work performance, the authors report that 75 percent of the pilot participants indicated increased feelings of satisfaction with their home life, and 44 percent reported having more quality time with their families.

John P. Robinson, Kevin Barth, and Andrew Kohut, "Social Impact Research: Personal Computers, Mass Media, and Use of Time," *Social Science Computer Review* 15(1):65–82.

This research aimed to determine whether home computing and Internet use displaces mass media (television, newspapers, magazines, books, radio, and movies). The authors analyze time-use data of computers, mass media, and the Internet obtained by the Pew Center for the People & the Press in national surveys conducted in 1994 and 1995. (These surveys are random digit dial telephone surveys with replacement sampling for nonresponse, whose target population is all individuals 18 years or older residing in the continental United States. The sample for this survey is based on a geographically stratified, random digit dial of working banks of telephone numbers in the continental United States. Results for the 1998 Technology Survey are based on telephone interviews conducted with 3,184 adults in the last quarter of 1998.)

The authors employed standard bivariate correlation analysis and multivariate regression. No statistically significant or systematic patterns of time displacement of the mass media by either personal computing or Internet use were found. This held true for light, moderate, and heavy users of computers and the Internet. The authors found that heavier computer usage is associated with significantly higher amounts of time spent using print media and movies; they conclude that, at this stage of development and diffusion, personal computers are more time enhancing with respect to the mass media than time displacing. They caution that more complete time diary studies must be conducted on home computing before the full time effects of computers are understood.

Charles W. Steinfeld, William H. Dutton, and Peter Kovaric, "A Framework and Agenda for Research on Computing in the Home," *Media Use in the Information Age: Emerging Patterns of Adoption and Consumer Use*, Jerry L. Salvaggio et al., eds. (Hillsdale, NJ: Lawrence Erlbaum Associates, 1989), pp. 61–85.

This chapter provides a framework for studying and analyzing home uses of the computer. The authors provide an extensive review of the literature on home computing and draw on lessons from household experiences with television and insights from computing impacts in organizations. They offer a typology for understanding patterns of PC use (based on frequency and diversity of use) and identify multiple factors that shape personal computing (social status, technical factors, sociocultural setting, and personal attributes). The authors then suggest a research agenda for studying patterns of computing use, which they argue is a prerequisite for theorizing and conducting research on the impacts of home computing. Areas of potential impact for home computing are identified, including education; family functioning; personal development; leisure activities; work from home; household routines; and privacy, civil liberties, and property rights.

Alladi Venkatesh, "Computers and Other Interactive Technologies for the Home," *Communications of the ACM* 39(12):47–54.

This article presents a framework for understanding the everyday activities of the household and potential linkages between those activities and information technologies. The author does not aim to analyze home impacts of IT, but to help home IT designers understand how families interact with IT. The article's relevance to the study of impacts of IT in the home derives from its useful description of the dynamics of a "cyberhousehold" and its reminder that it is not the presence of a technology in a household that matters, but how that technology is used. Theoretical insights into household adoption behaviors of new information technologies are also offered.

Alladi Venkatesh and Nicholas Vitalari, "A Post-Adoption Analysis of Computing in the Home," *Journal of Economic Pscyhology* 8:161–80.

This article reports how households use new computing technologies once they are introduced into the home. It was based on an availability sample of 282 members of computer clubs in Orange County, California. (The date of the study was not reported, but it was probably conducted in 1984.) Because this was not a probabilistic sample (club members were asked to volunteer for the study), its findings cannot be generalized to a larger population. They are, however, suggestive of future research and theory related to patterns of household adoption of computers.

According to the authors, after exploring several different indicators of computer use, "The results show that utilization patterns vary according to prior knowledge, household structure, and length of ownership."

Nicholas P. Vitalari, Alladi Venkatesh, and Kjell Gronhaug, "Computing in the Home: Shifts in the Time Allocation Patterns of Households," *Communications of the ACM* 28(5):512–22.

This study was an exploratory analysis of the impacts of home computers on the time allocation patterns of households for such activities as watching TV, hobbies, sleeping, studying, sports and outdoor recreation, and leisure time spent with friends and family. It was based on an availability sample of 282 members of computer clubs in Orange County, California. (The date of the study was not reported, but it was probably conducted in 1984.) Because this was not a probabilistic sample (club members were asked to volunteer for the study), its findings cannot be generalized to a larger population. They are, however, suggestive of future research and theory related to the impact of computing on other household activities. Participants were asked to complete a questionnaire related to computer use, user attitudes, levels of satisfaction with the computer, and user demographics.

Key findings include the following: (1) Only 6 percent of the respondents were female. (2) Most respondents (77 percent) had experience with computers before they purchased one for their home. (3) Primary computer use was distributed relatively equally among entertainment, word processing, business use, and hobby use, but few respondents (5 percent) indicated that they used the computer primarily for financial purposes. (4) There were notable decreases in time spent watching TV, working on hobbies, and sleeping; and notable increases in time spent alone and time spent studying and doing homework. (5) Age, income, and the presence of children in the household were the three demographic variables that were most strongly associated with differences between groups in the impact of computers on the household's patterns of time allocation.

APPENDIX C. MAJOR WORKS ORGANIZED BY KEYWORDS

ACCESS

Bruce, Margaret. 1988. "Home Interactive Telematics: New Technology With A History." Pp. 83–93 in *Concerning Home Telematics: Proceedings of the IFIP TC 9 Conference on Social Implications of Home Interactive Telematics, Amsterdam, The Netherlands, 24–27 June, 1987*, Felix Van Rijn and Robin Williams. Amsterdam: Elsevier Science Publishers.

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Venkatesh, Alladi and Nicholas Vitalari. 1986. "A Post-Adoption Analysis of Computing in the Home." *Journal of Economic Pscyhology* 8: 161–80.

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Hoffman, Donna L., William D. Kalsbeek, and Thomas P. Novak. December 1996. "Internet and Web Use in the U.S." *Communications of the ACM* 39(12): 36–46.

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Computer Usage

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